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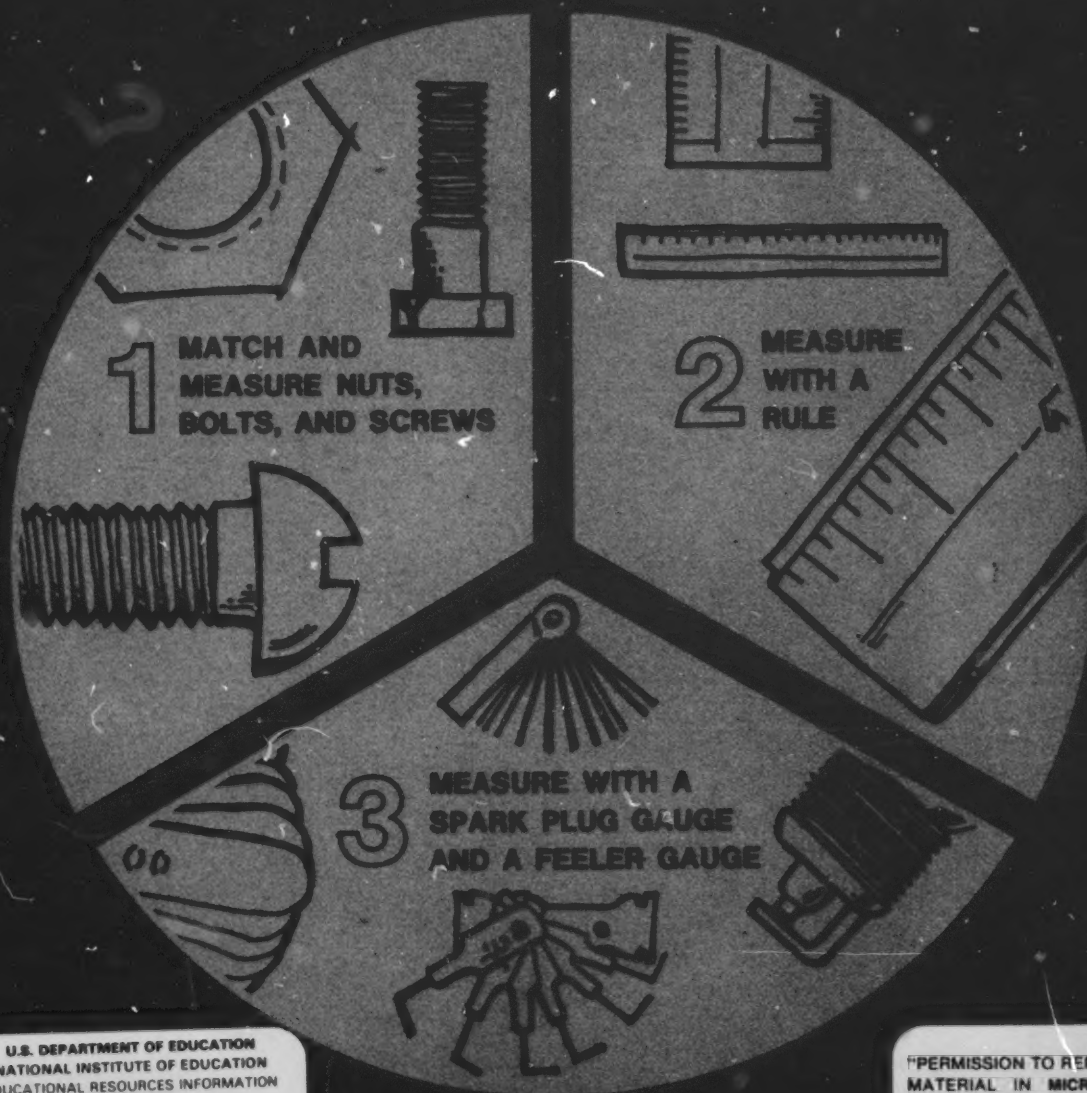
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**ABSTRACT**

This teacher's guide is part of an instructional series on small engine repair that is intended for use with mentally retarded and learning disabled students in general mechanical repair programs. Notes to the instructor cover equipment needed, preparation before teaching, and use of evaluation charts, transparency masters, audiovisual(s), and student activities. Other contents include a list of prerequisite skills, a chart of student goals and objectives, activities and materials to achieve them, a list of vocabulary terms, 20 transparency masters, six student activities to be used in conjunction with the viewing of one of the audiovisual presentations, answers to the activity sheets, an evaluation model with five evaluation charts, narratives for three audiovisual presentations, and a reference list. (This material has been developed as an extension of Comprehensive Small Engine Repair--ED 146 392--published by the Mid-American Vocational Curriculum Consortium, Inc. It is recommended that the two be used together.) (YLB)

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# MEASUREMENT



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**SMALL ENGINE REPAIR SERIES**

# **MEASUREMENT**

**Teacher's Guide**

*Published by*  
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**Occupational Curriculum Laboratory  
East Texas State University  
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**(214) 886-5623**

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# Teacher's Guide for Measurement

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Measure with a Rule  
Measuring Spark Plug Gap with Feeler Gauge

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## PREFACE

MEASUREMENT, an instructional package in the Small Engine Repair Series, was developed, field-reviewed, and evaluated by vocational industrial teachers who teach students about repairing small engines. This material was developed as an extension of Comprehensive Small Engine Repair by the Mid-America Vocational Curriculum Consortium, Inc., and we recommend the two be used together.

This project, now in its third year, was initiated in 1979 because it was felt that special needs students enrolled in General Mechanical Repair programs in Texas needed more appropriate instructional materials to aid their learning. The aim of this project has been twofold: (1) To task analyze the typical repair jobs of small engines and then identify the minimum required information, safety, and work habits associated with each repair job; and (2) To present this material in a variety of ways that are consistent with learning styles of special needs students with cognitive dysfunctions--primarily, the mentally retarded and learning disabled.

MEASUREMENT is designed with a combination of different media approaches--audio, visual, and hands-on. It is anticipated that this balanced multimedia approach will not only provide an opportunity for students to experience learning from different angles, but will also make learning more interesting and easier. Included in MEASUREMENT are the following instructional materials:

Audiovisuals: Measure and Match Nuts, Bolts, and Screws  
Measure With a Rule  
Measure with a Spark Plug Gauge and Feeler Gauge  
(This presentation includes three parts:  
measuring the spark plug gap, contact point  
gap, and valve stem gap.)

Teacher's Guide: with accompanying student activities

The presentations are available in filmstrip or slide/cassette style. They are short and concise, with simplified language to hold the interest of the special needs learner.

Designed to be used in both group and individual instruction, the audiovisual presentations may be used before and after discussion and/or demonstrations of measuring. If repetition is needed in order for a student to complete the Student Activity Sheets, the presentations may also be viewed individually without teacher assistance. For the student who is an auditory learner or blind, listening to the cassette will be an important aid in that student's ability to learn about measuring.

## TEACHER'S GUIDE

The Teacher's Guide will help provide successful learning experiences for the special needs student. Performance objectives are given for inclusion in a student's Individual Instructional Plan (IIP). Transparency Masters, the audiovisual scripts, Student Activity Sheets, and an evaluation chart are provided to support a variety of teaching methods and individualization of instruction.

For further information or to comment on MEASUREMENT or any of the presentations in the Small Engine Repair Series, contact the Occupational Curriculum Laboratory, Mayo Hall, East Texas State University, Commerce, Texas 75428, or phone (214) 886-5623.

## ACKNOWLEDGMENTS

Recognition for the successful development of MEASUREMENT is given to the Industrial Employers and Teachers Advisory Committee who conscientiously gave of their knowledge and time. Special thanks is extended to the following advisory members:

|                 |                       |                                    |
|-----------------|-----------------------|------------------------------------|
| Charles Francis | Briggs-Stratton Rep.  | Wahlburg-McCreary, Inc.<br>Houston |
| Don Talley      | Talley Auto Parts Co. | Commerce                           |
| Bill Gray       | Bill's Saw Shop       | Greenville                         |
| Robert Smith    | CVAE-GMR              | El Paso ISD                        |
| Pedro Ruiz      | CVAE-GMR              | Big Spring ISD                     |
| Carl Green      | CVAE-GMR              | Weatherford ISD                    |
| Thaddeus Curry  | VEH-GMR               | Klein ISD                          |
| Robert Svetlik  | CVAE-GMR              | Hallettsville ISD                  |
| Doyle Melton    | CVAE-GMR              | Austin ISD                         |
| Larry Kilbreth  | CVAE-GMR              | Pampa ISD                          |
| Jesse Swindle   | CVAE-GMR              | North Lamar ISD                    |
| Rex Davis       | CVAE-GMR              | Newton ISD                         |
| Fred Grimm      | CVAE-GMR              | Belton ISD                         |
| Vernon McGee    | CVAE-GMR              | Goose Creek ISD                    |
| Chuck Piggott   | CVAE-GMR              | Lyeford ISD                        |
| William Maroney | CVAE-GMR              | Alamo Heights ISD                  |
| Ignatius Dugosh | CVAE-GMR              | East Central ISD                   |

Appreciation is also given to those General Mechanical Repair instructors who field-reviewed MEASUREMENT at area in-service meetings in Texas. Their supportive comments, enthusiasm, and suggestions for changes were most valuable in the completion of this project.

### INTRODUCTION

This instructional package consists of three sets of full-color slides, cassette tapes, and a teacher's guide. The Teacher's Guide contains information on how to use this instructional package, the scripts for the audiovisual presentations, transparency masters, student activities, and student evaluation charts. These materials may be used as either primary or supplementary instructional materials for the topic of measuring. The printed materials provided in the Teacher's Guide are not copyrighted and so they may be reprinted in any form for student use. There are no separately printed student materials for MEASUREMENT.

### EQUIPMENT NEEDED

Before using this presentation, arrange to have the following equipment available:

- Projector (either carousel slide or filmstrip type)
- Carousel tray, if using slides
- Projector screen
- Cassette recorder
- Overhead projector and other equipment necessary for making transparencies
- Measuring tools and 4-stroke cycle gas engines

### PREPARATION BEFORE TEACHING THIS INSTRUCTIONAL PACKAGE

Before you begin teaching this instructional package, there are some things you should do. These will help ensure successful learning of MEASUREMENT by each student.

1. Preview all instructional materials provided in the Teacher's Guide, and view the audiovisual presentation.
2. Determine when and how these materials will be used in your class.
3. Assess each student for the Student Prerequisite Skills before introducing the instructional package. These prerequisite skills are provided in this guide.
4. Gather additional resources necessary to teach the prerequisite skills to those students who are deficient.

## STUDENT GOAL AND OBJECTIVES

The student goal and objectives for this instructional package follow the "Notes to the Instructor." Included with each objective are several suggestions for student activities, some of which are provided in this guide. These are to assist you in writing each student's Individual Instructional Plan (IIP).

1. Discuss the goal and objectives with each student so that it is clearly understood what is expected of the student.
2. Add any additional objectives such as prerequisite skills which need to be learned by the student.

## TRANSPARENCY MASTERS

Several 8½" by 10" illustrations have been provided in the Teacher's Guide to be used in a variety of ways:

1. As transparencies. If so, make an acetate of each illustration so that it may be projected onto a screen, using an overhead projector.
2. Copied and used as hand-outs to students.
3. As materials to be used in Student Activities.
4. As display materials for a bulletin board.

## PROCEDURES FOR SHOWING THE AUDIOVISUAL PRESENTATIONS

1. Plan a short, but relevant introduction to tell students what to look for in the presentation. Use the transparencies to help explain the information.
2. Allow enough time to show the presentation and for student discussion.
3. Show the audiovisual presentation to the students in a group or individual setting.

NOTE: "Measure with a Spark Plug Gauge and a Feeler Gauge" is divided into three parts. It is advised to plan an individual lesson around each part. The presentation is divided into the following parts:

Slides 1-18 Measuring Spark Plug Gap with Feeler Gauge  
 Slides 19-34 Measuring Contact Point Gap with Feeler Gauge  
 Slides 35-50 Measuring Valve Stem Gap with Feeler Gauge

4. Ask the students to highlight the major points of the presentation. Show the presentation a second time if necessary.
5. Stress the importance of accuracy in measuring.

### STUDENT ACTIVITIES

Student Activity Sheets to correspond with the audiovisual presentation, "Measure with a Rule," are provided to help reinforce the information presented. Directions for administering Student Activity Sheets are flexible in that they may serve as an outline for a group discussion or students may answer the questions individually and in writing.

### EVALUATION MODEL

It is encouraged that a grading system not be based on the written activities provided for the student, but rather on individual physical performance of measuring with the tools. Evaluation charts are provided in the Teacher's Guide for this purpose. The charts are intended for use as a grading instrument as a motivational aid by rating personal progress toward measuring.

1. Discuss with the students how they will be evaluated, based on individual performance shown by the evaluation chart.
2. See the section titled "Evaluation Chart" for specific instructions on how to use the evaluation chart.

## STUDENT PREREQUISITE SKILLS

Listed below are prerequisite skills which the student needs in order to successfully learn how to measure with various shop tools. It is recommended that the instructor teach these skills before or during the student learning of this instructional package.

### PREREQUISITE SKILLS

### SUGGESTED ACTIVITIES

#### Measure and Match Nuts, Bolts and Screws

- |                                                                                                                                                                                   |                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Demonstrate a working knowledge of commonly used vocabulary terms associated with "Measure and Match Nuts, Bolts and Screws"</li> </ol> | <p>Discuss "Vocabulary Terms" provided in the <u>Teacher's Guide</u>; use the "<u>Vocabulary Terms</u>" as a transparency or student handout; provide student drills on the terms; and other teacher-made reinforcement activities.</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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#### Measure with a Rule

- |                                                                                                                                                                       |                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Demonstrate a working knowledge of commonly used vocabulary terms associated with "Measure with a Rule"</li> </ol>          | <p>Discuss "Vocabulary Terms" provided in the <u>Teacher's Guide</u>; use the "<u>Vocabulary Terms</u>" as a transparency or student handout; provide student drills on the terms; and other teacher-made reinforcement activities.</p> |
| <ol style="list-style-type: none"> <li>2. Demonstrate a working knowledge of the addition of whole numbers and fractions through one-sixteenth of an inch.</li> </ol> | <p>Instruct student on how to add whole halves, fourths, eighths, and sixteenths of an inch.</p>                                                                                                                                        |

---

#### Measure with a Spark Plug Gauge and a Feeler Gauge

- |                                                                                                                                                                       |                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Demonstrate a working knowledge of commonly used vocabulary terms associated with measuring with a feeler gauge.</li> </ol> | <p>Discuss "Vocabulary Terms" provided in the <u>Teacher's Guide</u>; use the "<u>Vocabulary Terms</u>" as a transparency and student handout; provide student drills on the terms; and other teacher-made reinforcement activities.</p> |
| <ol style="list-style-type: none"> <li>2. Demonstrate the ability to locate various thicknesses of blades and wires on the feeler gauge and wire gauge.</li> </ol>    | <p>Provide the student with a round and flat feeler gauge and show where thickness specifications can be located on each.</p>                                                                                                            |

## STUDENT GOAL AND OBJECTIVES

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The following are provided to assist in the development and writing of each student's Individual Instructional Plan (IIP). Built into these objectives is the use of the evaluation chart found in this Teacher's Guide. You will want to use these charts for monitoring each student's progress toward these objectives. Criterion for competency or the rating that a student must achieve for a pre-determined length of time is suggested as a rating of 3 for three consecutive days on the evaluation chart. See "Evaluation Model," page 21, for further information.

LONG-TERM GOAL: After completing MEASUREMENT, the student will be able to measure and match nuts, bolts and screws, measure accurately with a rule to within one-sixteenth inch, and measure with two types of feeler gauges.

### SHORT-TERM OBJECTIVES

1. Given information about measuring and matching nuts, bolts and screws and an assortment of nuts, bolts and screws and wood blocks, and a wrench or socket set, the student will identify, explain, or demonstrate the following information for three consecutive days:
  - \* Definition of a fastener
  - \* Where internal and external threads are found on fasteners
  - \* The purpose of threads
  - \* Two types of threads used on fasteners
  - \* Which direction to turn fasteners in order to tighten and loosen them.
  - \* Three kinds of information necessary for ordering replacement fasteners
  - \* How to measure the length of fasteners
  - \* How to measure the diameter of fasteners

### ACTIVITIES AND MATERIALS

1. Watch the audiovisual presentation "Measure and Match Nuts, Bolts and Screws."
2. Participate in class discussions.
3. Observe the teacher demonstrating how to measure and match various nuts, bolts and screws.
4. Practice measuring and matching an assortment of nuts and bolts that assemble together.
5. Practice measuring and matching of screws mounted into wood with the correct size wrench or socket.

SHORT-TERM OBJECTIVES

- \* How to determine the number of threads per inch on a fastener
- \* How to select the correct size socket to fit on a bolt or screw head
- \* Safety rules to follow when loosening or tightening fasteners
- \* When to use a standard depth socket or deep socket

ACTIVITIES AND MATERIALS

2. Given information on measuring with a rule, paper and pencil exercises, a rule, and various objects to measure, the student will identify, explain, or demonstrate the following information for three consecutive days:

- \* The 4 common measurement fractions in one inch
- \* The fraction each division line represents
- \* When fractions can be reduced
- \* The definition of measurement
- \* The definition of fraction
- \* Measure in whole, half, fourth, eighth and sixteenth inch

1. Watch the audiovisual presentation "Measure with a Rule;" participate in class discussions.
2. Using the audiovisual presentation, answer the questions on Student Activity sheets 1-6.
3. Practice measuring an assortment of objects with a rule.
4. Using the Measurement Evaluation Chart, rate the student's progress for two consecutive weeks, or until a rating of 3 is achieved for three consecutive days.

SHORT-TERM OBJECTIVES

3. a. Given a spark plug and a feeler gauge and information about measuring with a spark plug gauge and a feeler gauge, the student will identify, explain or demonstrate the following information for three consecutive days:

- \* The reason a round feeler gauge is used to measure the spark plug gap instead of a flat feeler gauge
- \* How to locate the correct spark plug gap size in a small engine repair manual
- \* How to select the correct feeler gauge blade for the spark plug gap specifications found in the repair manual
- \* Check the spark plug gap for the correct setting

- b. Given a set of contact points and a feeler gauge and information about measuring contact points with a feeler gauge, the student will identify, explain or demonstrate the following information for three consecutive days:

- \* The reason the contact point gap must be correctly set.
- \* How to find the correct contact point gap setting in a small engine repair manual

ACTIVITIES AND MATERIALS

1. Watch the audiovisual presentation "Measure with a Spark Plug Gauge and a Feeler Gauge Part 1: Measuring the Spark Plug Gap with a Feeler Gauge."
  2. Participate in class discussions.
  3. Observe the teacher demonstrating the steps of measuring and setting the spark plug gap with a feeler gauge.
  4. Practice measuring and setting the spark plug gap with a feeler gauge.
  5. Using the evaluation chart "Measure the Spark Plug Gap with a Feeler Gauge" rate the student's progress for two consecutive weeks or until a rating of 3 is achieved for three consecutive days.
- 
1. Watch the audiovisual presentation, "Measure with a Spark Plug Gauge and a Feeler Gauge Part 2: Measuring the Contact Point Gap with a Feeler Gauge."
  2. Participate in class discussion.
  3. Observe the teacher demonstrating the steps of measuring and setting the contact point gap with a feeler gauge.
  4. Practice measuring and setting the contact point gap with a feeler gauge.

SHORT-TERM OBJECTIVES

3. c. Given an engine block with valve and a feeler gauge and information about measuring the valve stem gap with a feeler gauge, the student will identify, explain or demonstrate the following information for three consecutive days:
  - \* The reason the valve stem gap must be correctly set
  - \* How to find the correct valve stem gap settings in a small engine repair manual
  - \* How to select the correct feeler gauge blade for the valve gap specifications section in the repair manual
  - \* How to position the intake and exhaust valves for measuring
  - \* Check both exhaust and intake valve gap for correct setting

ACTIVITIES AND MATERIALS

1. Watch the audiovisual presentation, "Measure with a Spark Plug Gauge and a Feeler Gauge Part 3: Measuring Valve Stem Gap with Feeler Gauge."
2. Participate in class discussions.
3. Observe the teacher demonstrating the steps of measuring and setting the valve stem gap with a feeler gauge.
4. Practice measuring and setting the valve stem gap with a feeler gauge.
5. Using the evaluation chart "Measuring the Valve Stem Gap with a Feeler Gauge," rate the student's progress for two consecutive weeks or until a rating of 3 is achieved for three consecutive days.

## VOCABULARY TERMS FOR MEASUREMENT

The following vocabulary terms are words that are frequently found throughout this instructional package. These terms and their definitions are provided to aid the student in developing a common language that is often used in the small engine repair classroom.

A. VOCABULARY TERMS ASSOCIATED WITH "MEASURE AND MATCH NUTS, BOLTS, AND SCREWS"

1. Bolt--Threaded fastener used with a nut.
2. Cap Screw--A threaded fastener that screws into a threaded hole, designed to be tightened or loosened with a wrench or socket.
3. Clockwise--Turn fastener to the right.
4. Counter clockwise--Turn fastener to the left.
5. Cross-thread--Internal threads and external threads not fitting together properly.
6. External threads--Threads cut on the outside of a fastener such as a bolt or a screw.
7. Fasteners--Small threaded devices such as nuts, bolts, and screws that fasten or hold small engine parts together.
8. Internal threads--Threads cut in the inside of a fastener, such as a nut.
9. Nut--Small fastener having internal threads used with bolts and screws.
10. Screw--A threaded fastener that fits into a threaded hole.
11. Shroud--A protective cover that fits over the flywheel and helps direct air over the engine to carry away heat.
12. Stud--A fastener with threads at both ends.
13. Threads--Grooved or hollow channels cut into nuts, bolts, and screws that gives them holding power.
14. Vibration--A back and forth shaking movement.

B. VOCABULARY TERMS ASSOCIATED WITH "MEASURE WITH A RULE"

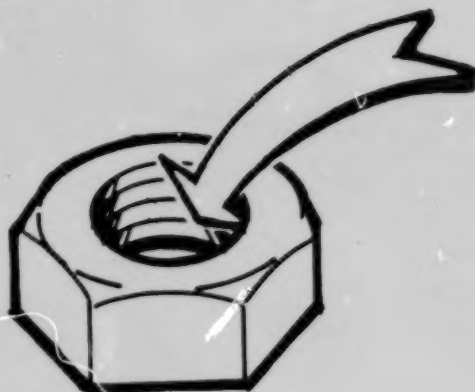
1. Eighth--Means there are eight equal parts in one-inch.
2. Even number--Any number that can be divided by the number 2.
3. Fraction--Any measurement that is less than one-inch.

4. Fourth--Means there are four equal parts in one-inch.
5. Half--Means there are two equal parts in one-inch.
6. Odd Number--Any number that cannot be divided by the number 2.
7. Measure--To determine the length of something.
8. Reduce--To make into a smaller number.
9. Rule--A straight piece of wood or metal used to measure length, width, and thickness.
10. Sixteenth--Means there are sixteen equal parts in one inch.

C. VOCABULARY TERMS ASSOCIATED WITH "MEASURE WITH A SPARK PLUG GAUGE AND A FEELER GAUGE"

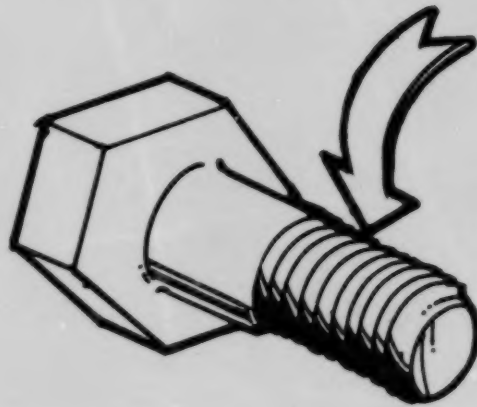
1. Center Electrode--The non-adjustable electrode on a spark plug.
2. Contact Gap--The space between the contacts when they are fully open.
3. Contact Points--An electrical device used to stop the electrical current in the ignition system.
4. Electrode--Two metal surfaces that carry electricity which are separated by a gap.
5. Exhaust Valve--A device used to let burned gases out of the combustion chamber or cylinder.
6. Feeler Gauge--A measuring tool used to measure accurately the space between two metal surfaces.
7. Gap--A space between two surfaces.
8. Gap Setter--A tool used to bend the ground electrode to make the gap smaller or larger.
9. Ground Electrode--The adjustable electrode on a spark plug.
10. Hold Down Screw--A fastener that keeps a stationery contact point in place.
11. Intake Valve--A device used to control the amount of air and gas put into the combustion chamber.
12. Spark Plug--A part of the engine that provides a gap for electricity to jump, producing a spark of fire to ignite the fuel mixture in the combustion chamber.

# INTERNAL THREADS



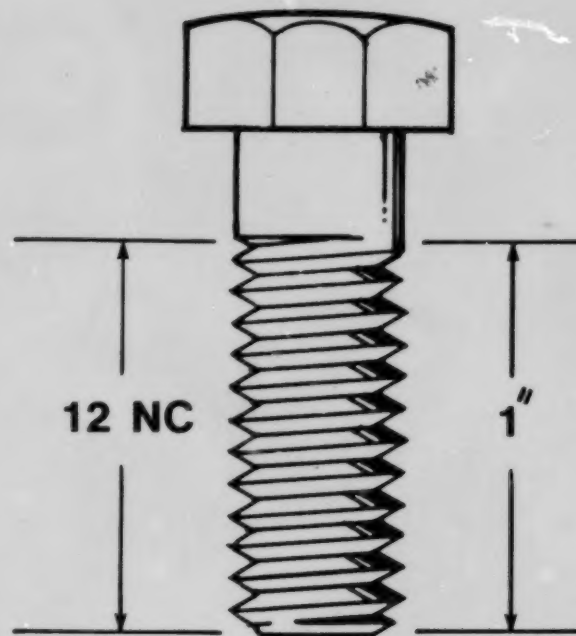
TM-1

## EXTERNAL THREADS

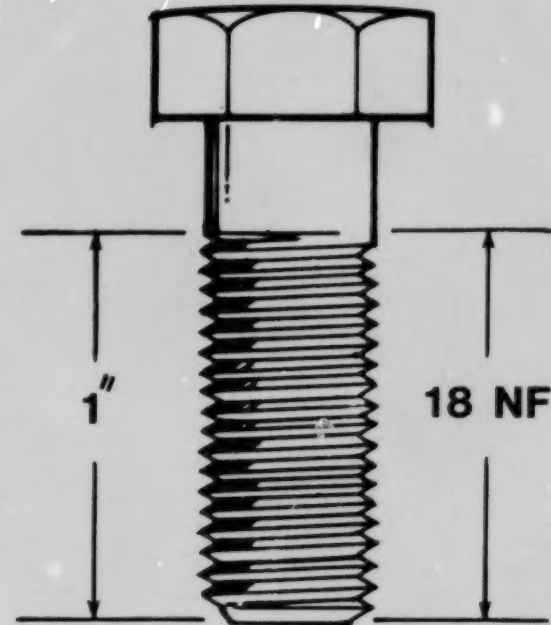


TM-2

## COARSE AND FINE THREADS



**coarse**



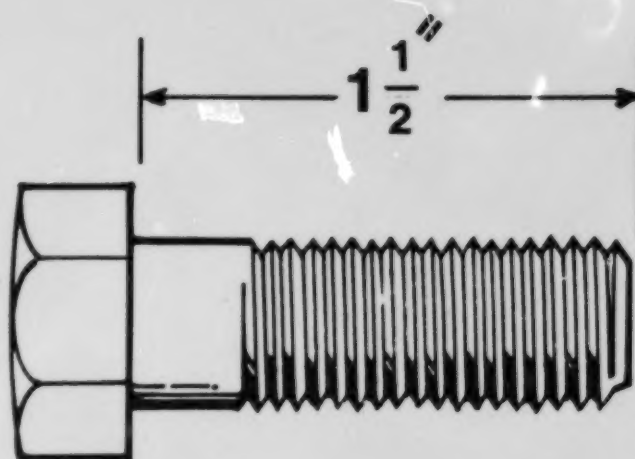
**fine**

# AMERICAN NATIONAL STANDARD SCREW THREADS

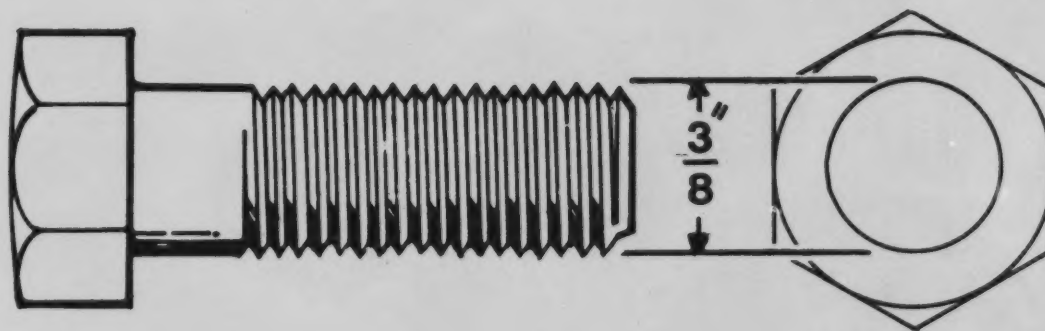
| DIAMETER OF<br>SCREW OR BOLT | NC<br>THREADS<br>PER INCH | NF<br>THREADS<br>PER INCH |
|------------------------------|---------------------------|---------------------------|
| 1/4                          | 20                        | 28                        |
| 5/16                         | 18                        | 24                        |
| 3/8                          | 16                        | 24                        |
| 7/16                         | 14                        | 20                        |
| 1/2                          | 13                        | 20                        |
| 9/16                         | 12                        | 18                        |
| 5/8                          | 11                        | 18                        |
| 3/4                          | 10                        | 16                        |
| 7/8                          | 9                         | 14                        |
| 1                            | 8                         | 14                        |

TM-4

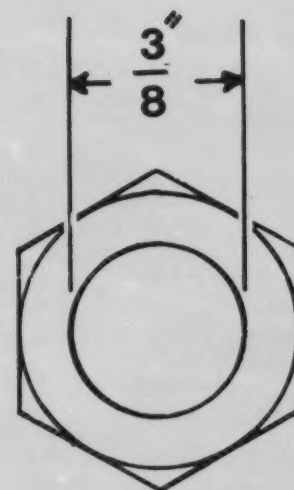
## MEASURING LENGTH OF A BOLT

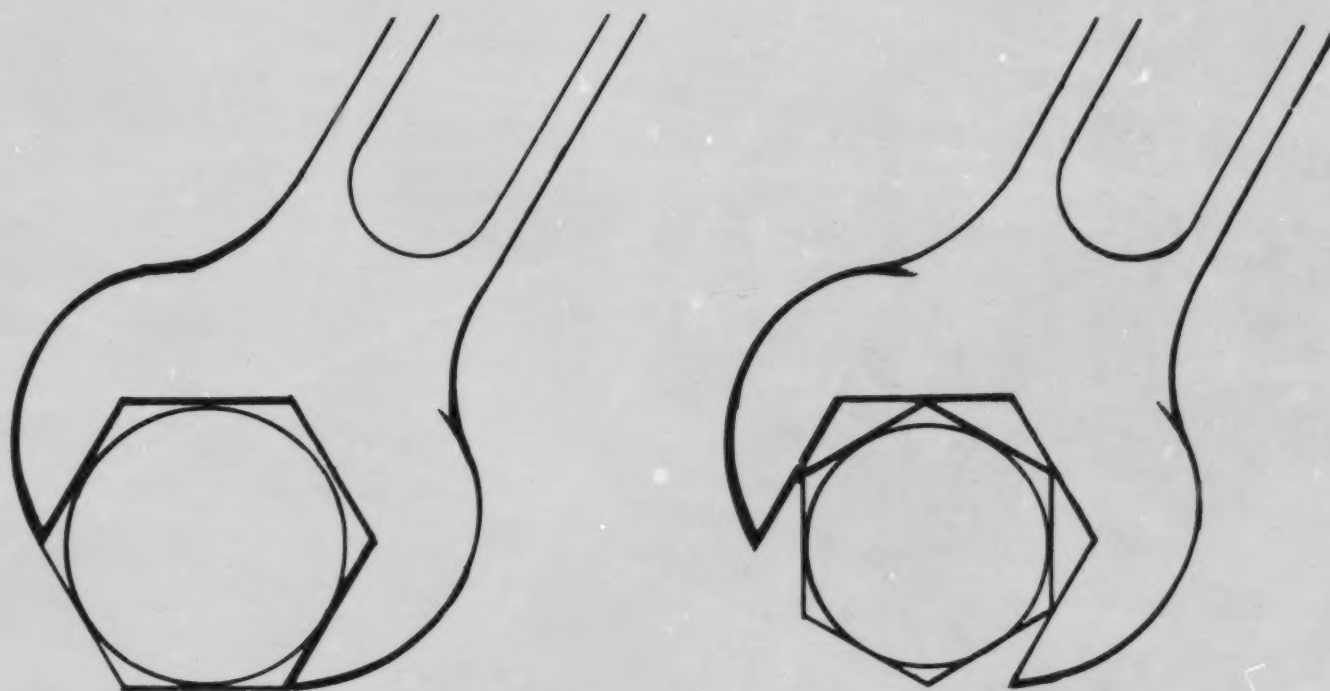


## MEASURING DIAMETER OF A BOLT AND NUT



## MATCHING THE DIAMETER OF BOLT HEAD WITH THE WRENCH



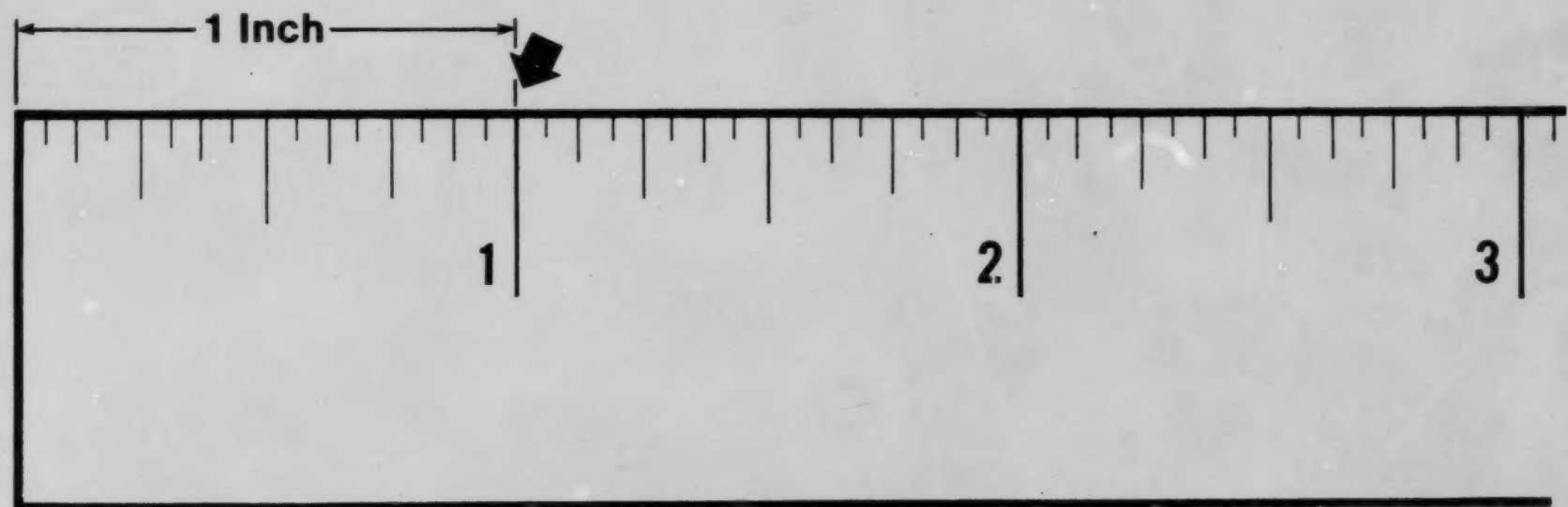


**SAFETY TIP: Correctly fit the wrench onto the bolt head or size nut**

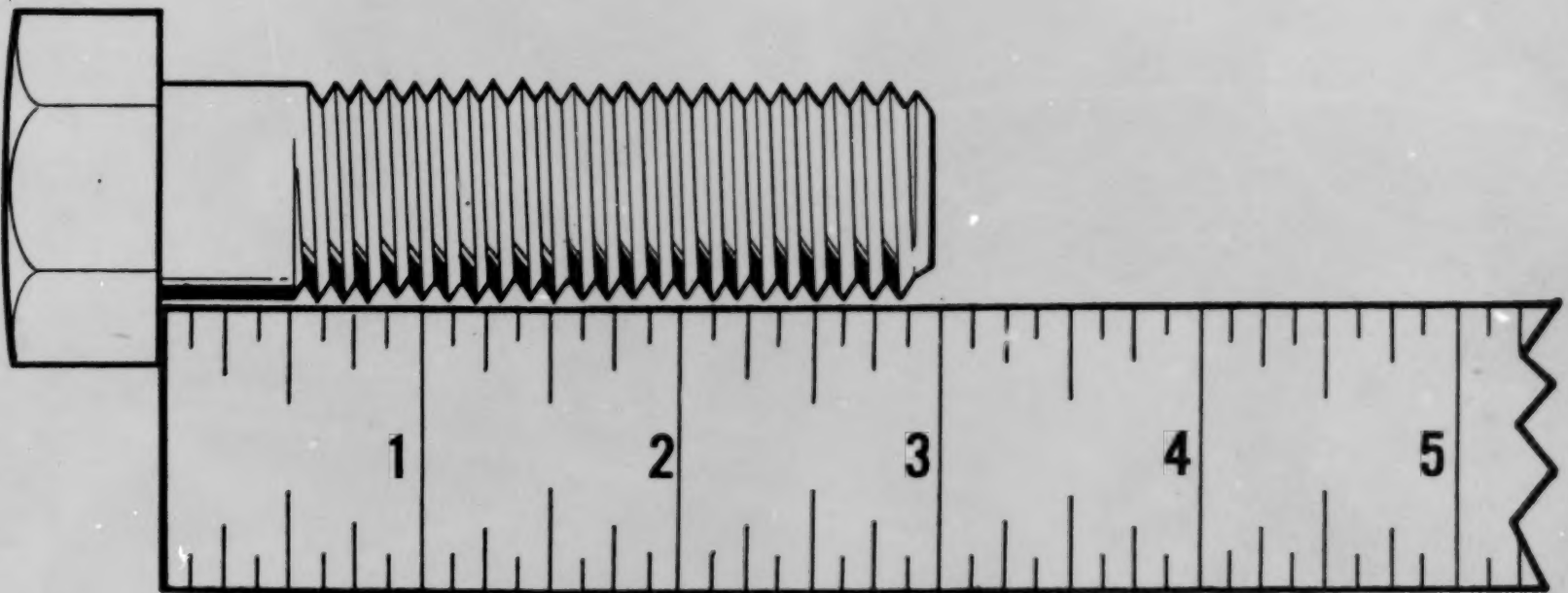


**SAFETY TIP: Never use anything stronger than hands on a wrench**

## ONE-INCH MARK ON A RULE



## MEASURING IN WHOLE INCHES

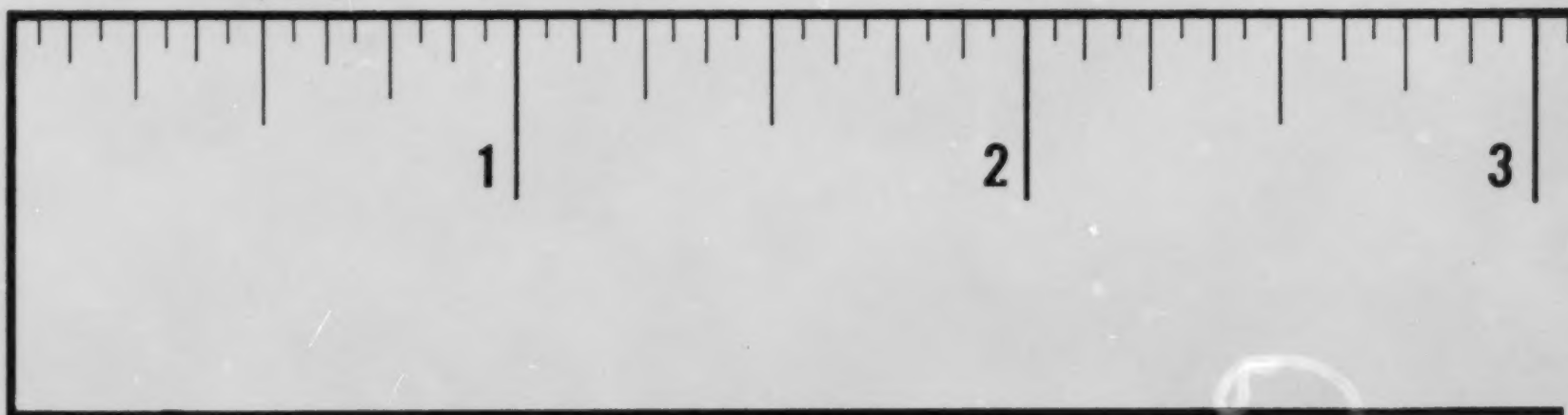


TT-11

33

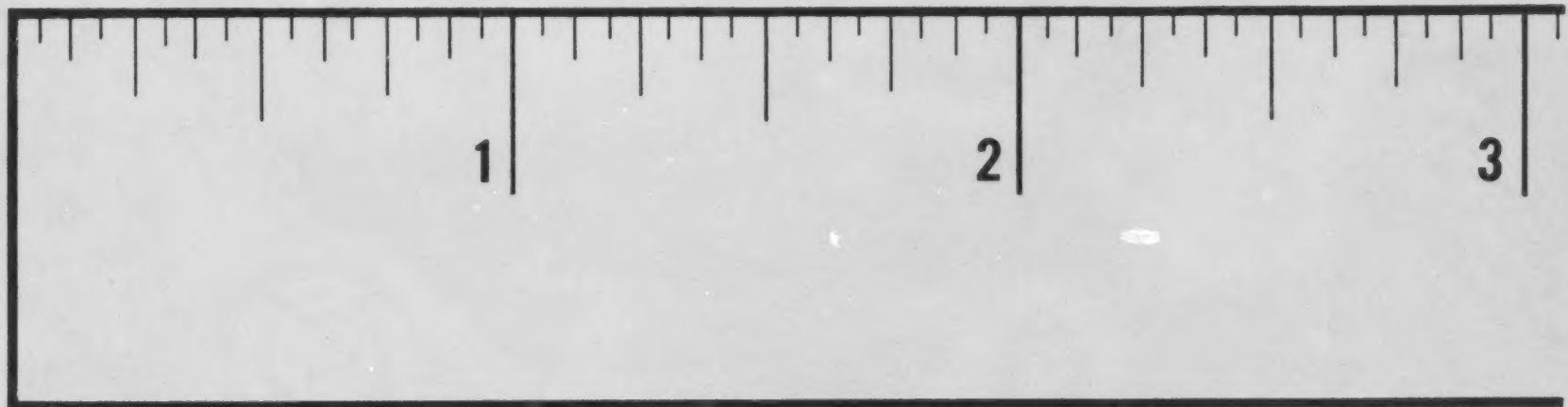
## FRACTIONS ON A RULE

Fractions



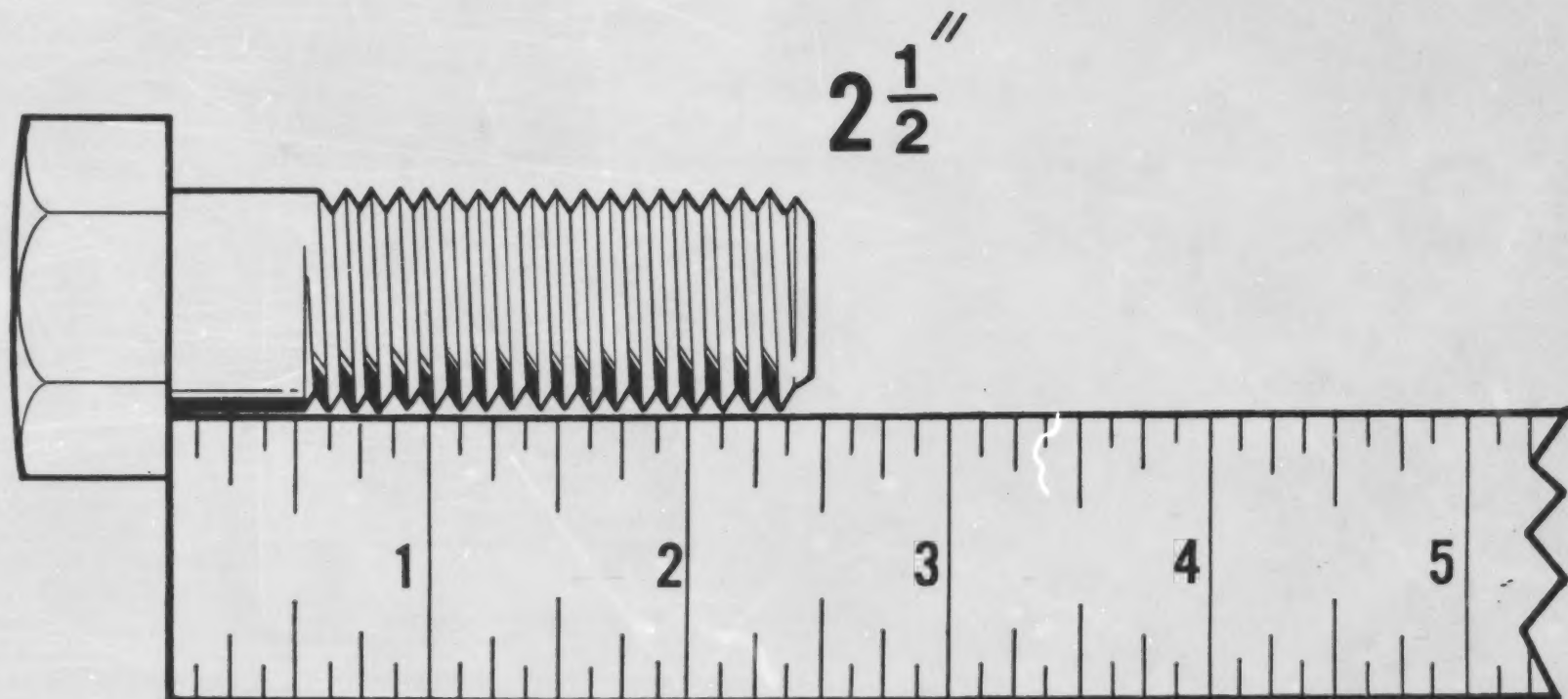
# ONE-HALF INCH MARK

Half-inch



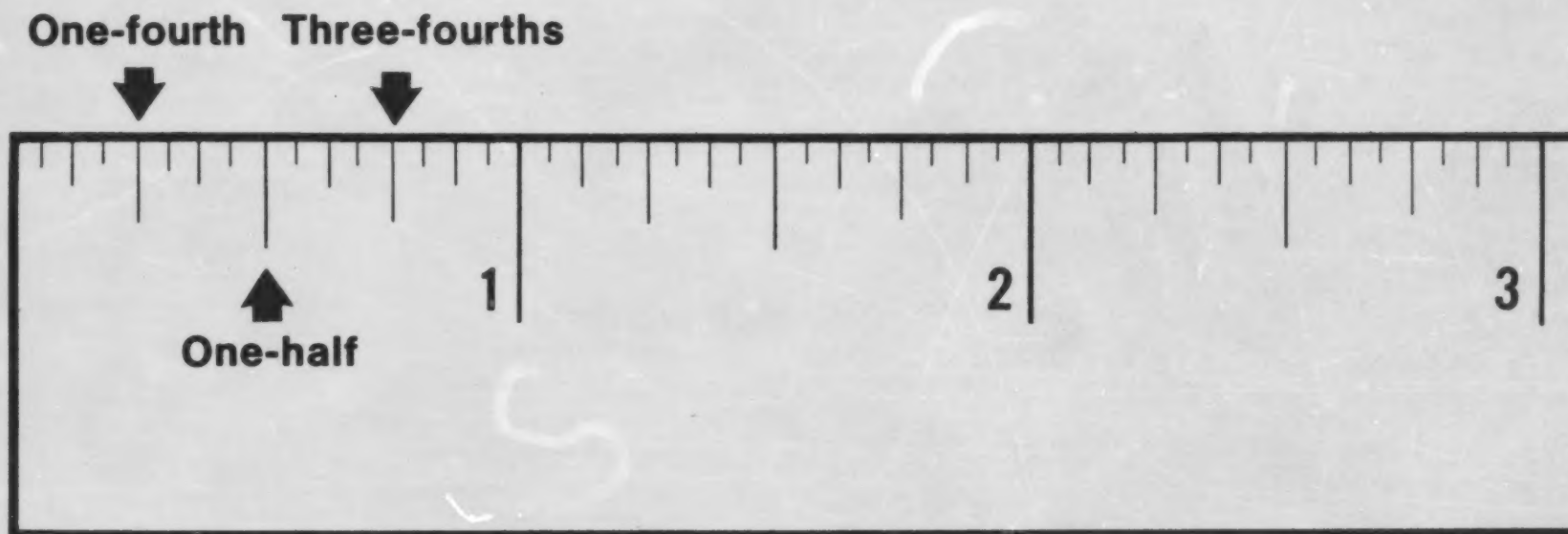
TM-13

## MEASURING IN HALF INCHES



One inch...two inches...and one-half

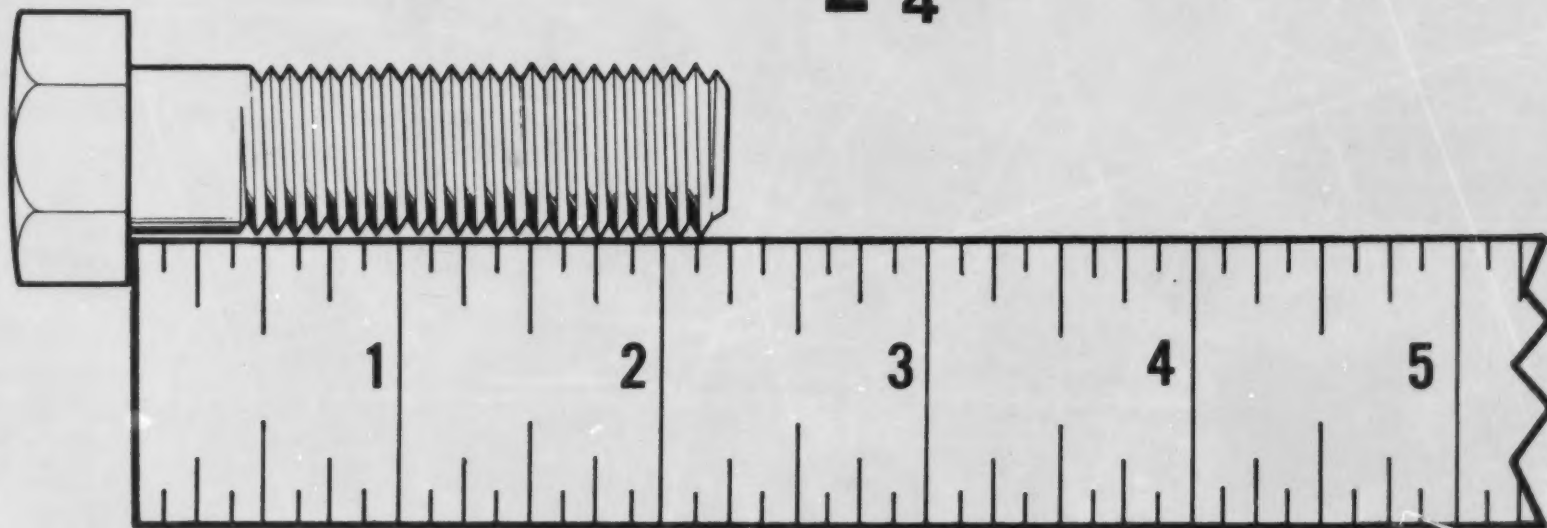
## ONE-FOURTH INCH MARKS



Fourths

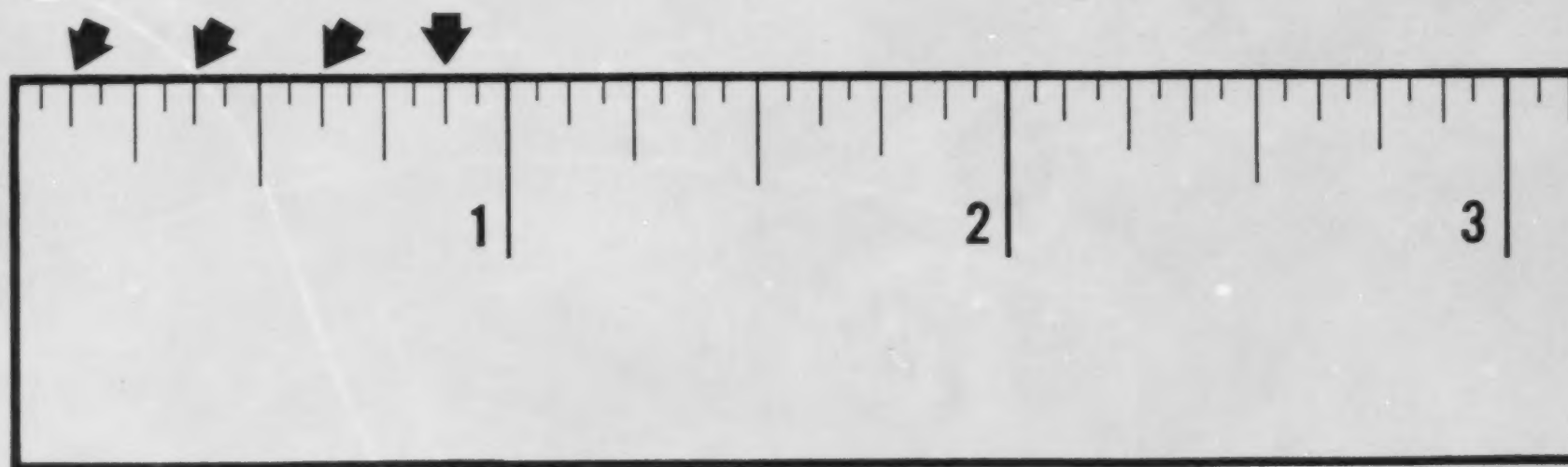
## MEASURING IN FOURTH INCHES

$2 \frac{1}{4}''$



One inch...two inches...and one-fourth

## ONE-EIGHTH INCH MARKS

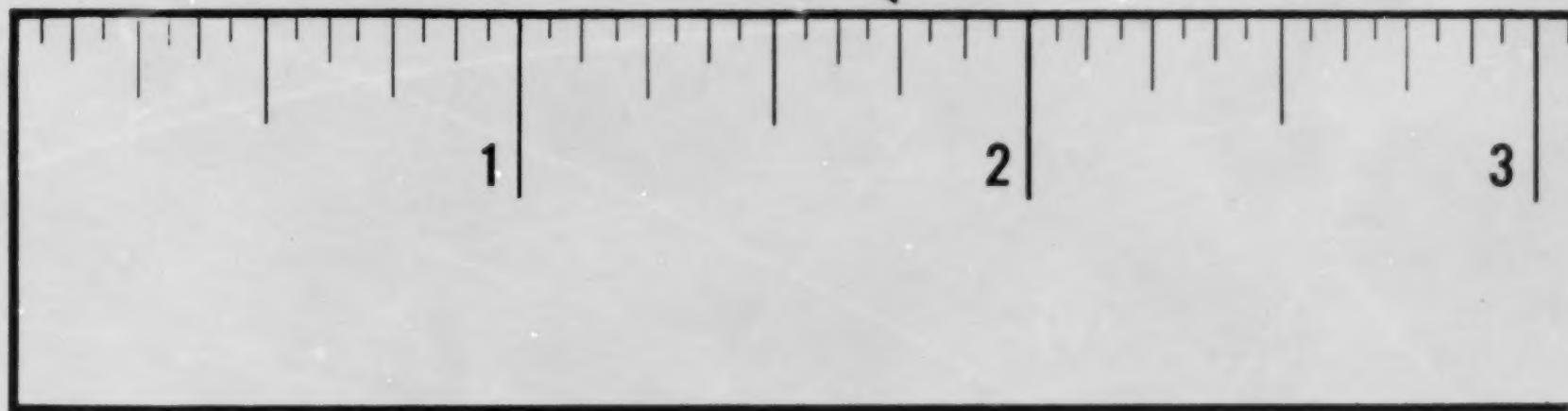


TM-17

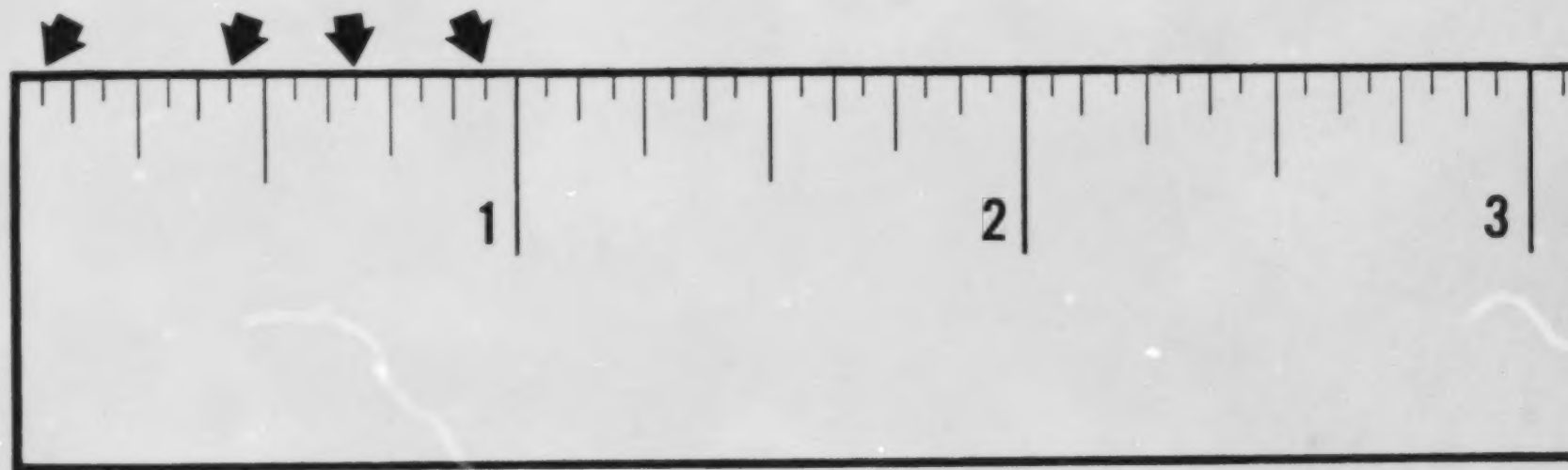
## MEASURING IN EIGHTH INCHES

Bolt that measures  $2\frac{6}{8}$ " on rule

$$\frac{\cancel{6}^{\cancel{3}}}{\cancel{8}^{\cancel{4}}} = \frac{3}{4}$$



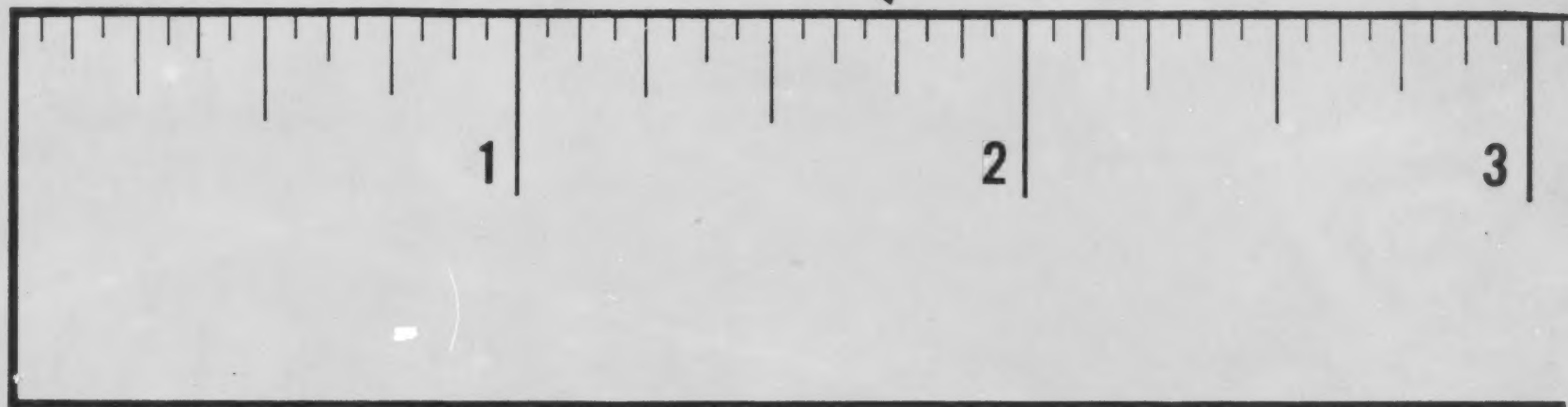
## ONE-SIXTEENTH INCH MARKS



## MEASURING IN SIXTEENTH INCHES

Bolt that measures  $1\frac{12}{16}$ " on rule

$$\frac{\cancel{12}^3}{\cancel{16}^4} = \frac{3}{4}$$



MEASURE WITH A RULE  
STUDENT ACTIVITY SHEETS

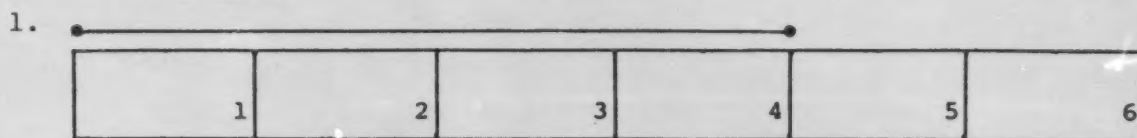
The following six student activities are to be used in conjunction with the viewing of the audiovisual presentation, "Measure with a Rule."

J  
O  
B

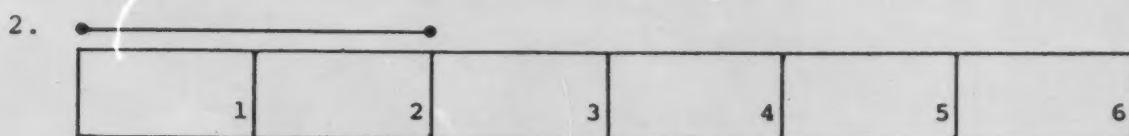
## Activity Sheet 1

## Measuring in Whole Inches

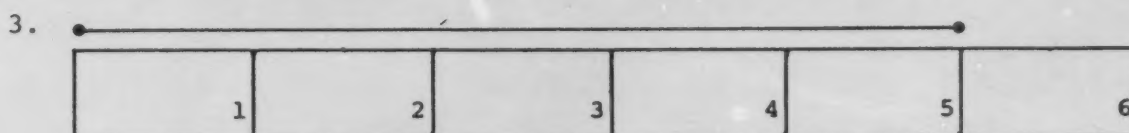
- A. Look at each line and look at the rule below it. Then write down how long each line is.



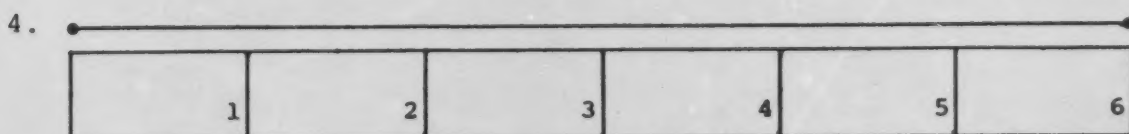
\_\_\_\_\_ inches



\_\_\_\_\_ inches

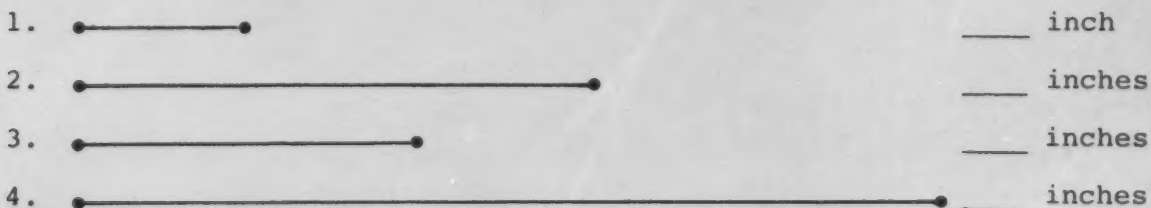


\_\_\_\_\_ inches



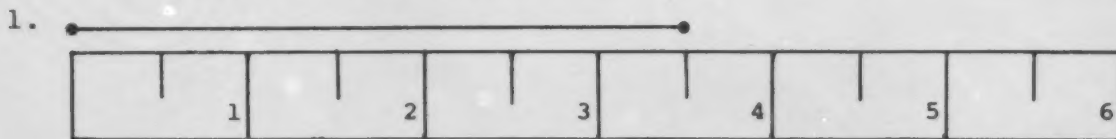
\_\_\_\_\_ inches

- B. With your rule, measure each of the lines below, and write down your answer.

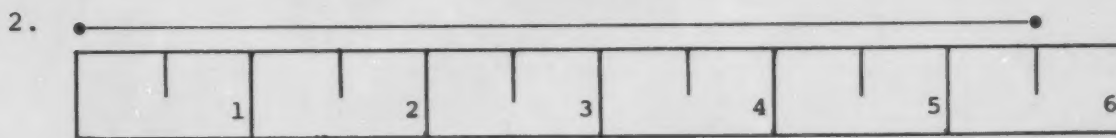


## Measuring in Whole and Half Inches

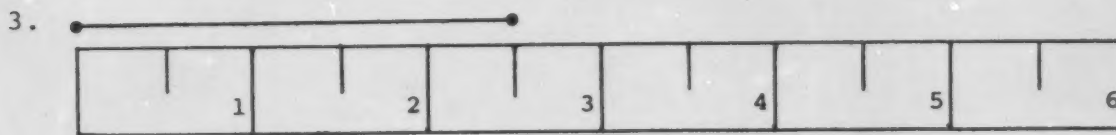
- A. Look at each line and look at the rule below it. Then write down how long each line is.



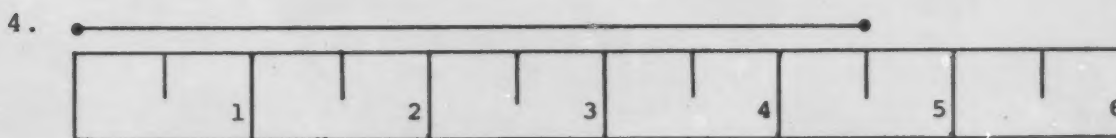
\_\_\_\_\_ inches



\_\_\_\_\_ inches



\_\_\_\_\_ inches



\_\_\_\_\_ inches

- B. With your rule, measure each of the lines below and write down your answer.

1. \_\_\_\_\_ inches

2. \_\_\_\_\_ inches

3. \_\_\_\_\_ inches

4. \_\_\_\_\_ inches

C. Using your rule, draw a line that is the same as each of the measurements given. Start at the dot after each number.

1. 2 inches ●

2.  $2\frac{1}{2}$  inches ●

3. 5 inches ●

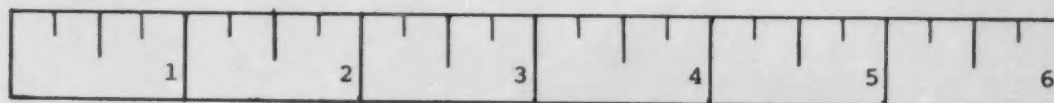
4. 1 inch ●

## Activity Sheet 3

## Measuring in Whole and Fourth Inches

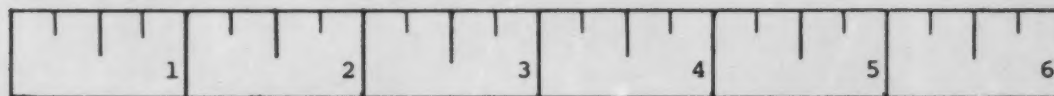
- A. Look at each line and look at the rule below it. Then write down how long each line is.

1. 



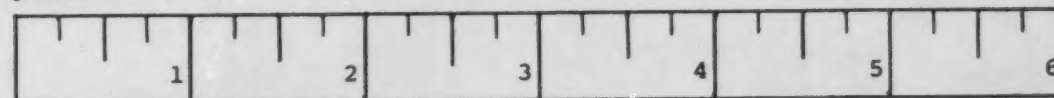
\_\_\_\_\_ inches

2. 



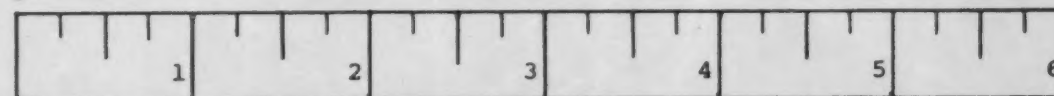
\_\_\_\_\_ inches

3. 



\_\_\_\_\_ inch

4. 



\_\_\_\_\_ inches

- B. With your rule, measure each of the lines below and write down your answer.

1.  \_\_\_\_\_ inches

2.  \_\_\_\_\_ inches

3.  \_\_\_\_\_ inches

4.  \_\_\_\_\_ inch

- C. Using your rule, draw a line for each of the measurements given. Start at the dot after each number.

1.  $4 \frac{3}{4}$ " •

2.  $2 \frac{1}{4}$ " •

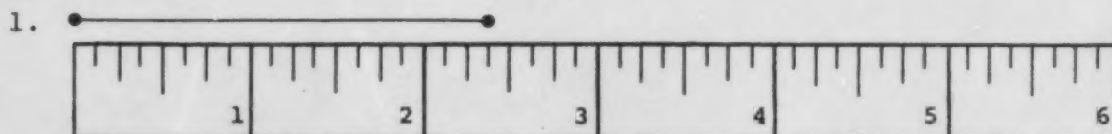
3.  $\frac{3}{4}$ " •

4.  $1 \frac{1}{4}$ " •

## Activity Sheet 4

## Measuring in Whole and Eighth Inches

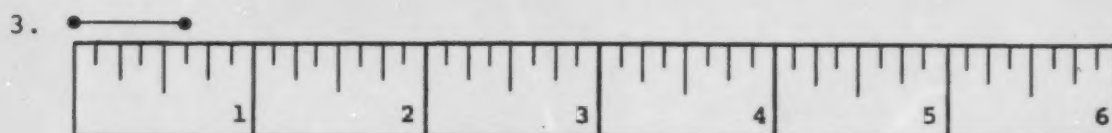
A. Look at each line and look at the rule below it. Then write down how long each line is in the space below the rule.



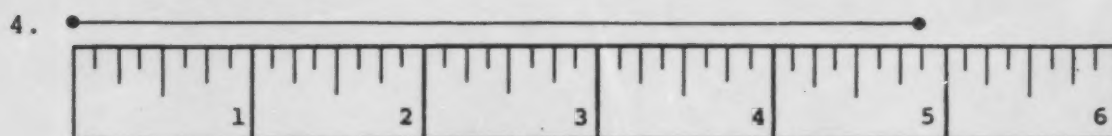
\_\_\_\_\_ inches



\_\_\_\_\_ inches



\_\_\_\_\_ inches



\_\_\_\_\_ inches

B. With your rule, measure each of the lines below. Then write your answer in the spaces at the side.

- |                                                                                         |              |
|-----------------------------------------------------------------------------------------|--------------|
| 1.   | _____ inches |
| 2.   | _____ inches |
| 3.   | _____ inches |
| 4.  | _____ inches |

C. Using your rule, draw a line that is the same as each of the measurements given. Start at the dot after each number.

1.  $2 \frac{5}{8}$  •

2.  $5 \frac{1}{8}$  •

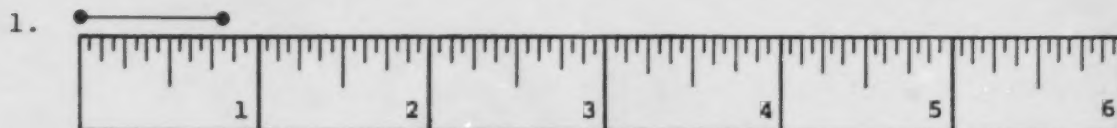
3.  $3 \frac{3}{8}$  •

4.  $\frac{7}{8}$  •

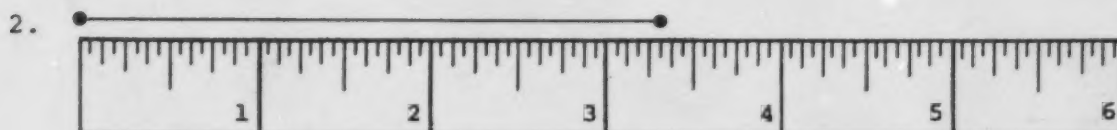
## Activity Sheet 5

## Measuring in Whole and Sixteenth Inches

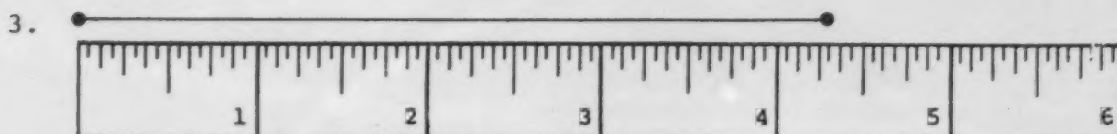
- A. Look at each line and look at the rule below it. Then write down how long each line is in the space below the rule.



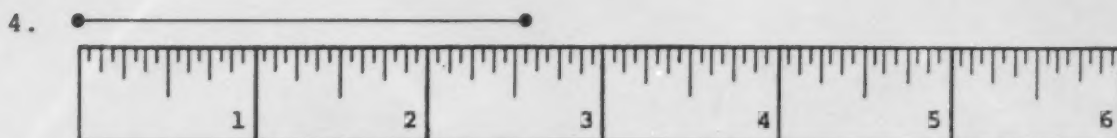
\_\_\_\_\_ inch



\_\_\_\_\_ inches



\_\_\_\_\_ inches



\_\_\_\_\_ inches

- B. With your rule, measure each of the lines below, and then write down your answer in the spaces at the side.

1.  \_\_\_\_\_ inches

2.  \_\_\_\_\_ inches

3.  \_\_\_\_\_ inches

4.  \_\_\_\_\_ inches

C. Using your rule, draw a line that is the same length as each of the measurements given. Start at the dot after each number.

1.  $5 \frac{3}{16}$  •

2.  $1 \frac{7}{16}$  •

3.  $3 \frac{13}{16}$  •

4.  $\frac{15}{16}$  •

## Activity Sheet 6

## Measuring in Whole and Fractional Inches

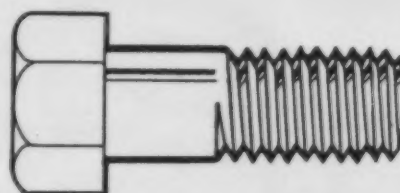
With your rule, measure each of the bolts shown below. Then write down your answers in the spaces below each bolt. HINT: You will be measuring in whole inches,  $\frac{1}{2}$  inches,  $\frac{1}{4}$  inches,  $\frac{1}{8}$  inches, and  $\frac{1}{16}$  inches only.

1.



\_\_\_\_\_ inches

2.



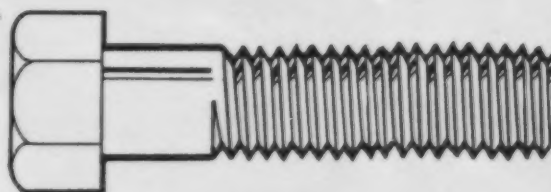
\_\_\_\_\_ inches

3.



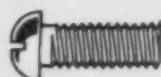
\_\_\_\_\_ inches

4.



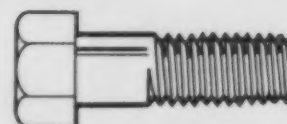
\_\_\_\_\_ inches

5.



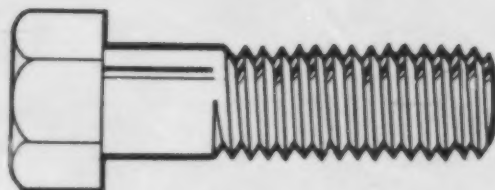
\_\_\_\_\_ inches

6.



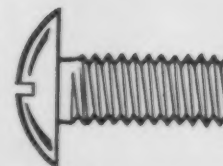
\_\_\_\_\_ inches

7.



\_\_\_\_\_ inches

8.



\_\_\_\_\_ inches

9.



\_\_\_\_\_ inches

10.



\_\_\_\_\_ inches

## ANSWERS TO STUDENT ACTIVITIES

## STUDENT ACTIVITY 1: Measuring in Whole Inches

- A. 1. 4                      2. 2                      3. 5                      4. 6  
 B. 1. 1                      2. 3                      3. 2                      4. 5

## STUDENT ACTIVITY 2: Measuring in Whole and Half Inches

- A. 1.  $3 \frac{1}{2}$                       2.  $5 \frac{1}{2}$                       3.  $2 \frac{1}{2}$                       4.  $4 \frac{1}{2}$   
 B. 1.  $1 \frac{1}{2}$                       2.  $4 \frac{1}{2}$                       3.  $3 \frac{1}{2}$                       4.  $5 \frac{1}{2}$

## STUDENT ACTIVITY 3: Measuring in Whole and Fourth Inches

- A. 1.  $1 \frac{1}{4}$                       2.  $2 \frac{3}{4}$                       3.  $\frac{3}{4}$                       4.  $5 \frac{1}{2}$   
 B. 1.  $3 \frac{1}{4}$                       2.  $2 \frac{3}{4}$                       3.  $1 \frac{3}{4}$                       4.  $1 \frac{1}{4}$

## STUDENT ACTIVITY 4: Measuring in Whole and Eighths Inches

- A. 1.  $2 \frac{3}{8}$                       2.  $3 \frac{1}{8}$                       3.  $\frac{5}{8}$                       4.  $4 \frac{7}{8}$   
 B. 1.  $\frac{7}{8}$                       2.  $3 \frac{1}{4}$                       3.  $1 \frac{5}{8}$                       4.  $4 \frac{3}{8}$

## STUDENT ACTIVITY 5: Measuring in Whole and Sixteenths Inches

- A. 1.  $\frac{13}{16}$                       2.  $3 \frac{5}{16}$                       3.  $4 \frac{5}{16}$                       4.  $2 \frac{9}{16}$   
 B. 1.  $\frac{7}{16}$                       2.  $4 \frac{3}{16}$                       3.  $1 \frac{5}{8}$                       4.  $3 \frac{1}{16}$

## STUDENT ACTIVITY 6: Measuring in Whole and Fractional Inches

1.  $1 \frac{1}{4}$   
 2.  $1 \frac{3}{4}$   
 3.  $1 \frac{1}{8}$   
 4.  $2 \frac{5}{8}$   
 5.  $\frac{11}{16}$   
 6.  $1 \frac{1}{4}$   
 7.  $2 \frac{1}{4}$   
 8. 1  
 9. 2  
 10.  $\frac{1}{2}$

## EVALUATION MODEL

The charts on the following pages are to be used by the teacher as motivational aids and by the student as self-evaluation of individual progress toward learning information about measuring and using measuring tools.

The evaluation of each student's knowledge and performance should begin after the student completely understands what is expected and some demonstrated progress toward the objectives is evident. Because the learning rate in some special needs students varies greatly, the evaluation period will also vary among students. However, it is recommended that evaluation should last for a minimum period of two weeks or ten consecutive school days. This length of time will allow most students to overlearn the measurement objectives and thus achieve competency.

The rating scale for the following evaluation chart is divided into three steps.

| <u>RATING</u> | <u>MEANING</u>                                                                 |
|---------------|--------------------------------------------------------------------------------|
| 1             | Does not reach the objective.                                                  |
| 2             | Reaches the objective, but needs help or needs to be reminded.                 |
| 3             | Reaches the objective without help. Ready for job entry with shop supervision. |

Criterion for competency or the rating that a student must achieve for a predetermined length of time is suggested to be a rating of 3 on the evaluation chart for three consecutive days. For example, when a student is able to demonstrate knowledge about measurement and demonstrates the ability to use the various measurement tools without help for three consecutive days, then the student has reached criterion and is considered competent in that area.



| <b>Measure and Match<br/>Nuts, Bolts, and Screws</b><br><br><b>EVALUATION CHART</b> | DAYS |   |   |   |   |   |   |   |   |    |
|-------------------------------------------------------------------------------------|------|---|---|---|---|---|---|---|---|----|
|                                                                                     | 1    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| <b>THINGS TO KNOW</b>                                                               |      |   |   |   |   |   |   |   |   |    |
| 1. States the definition of a fastener                                              |      |   |   |   |   |   |   |   |   |    |
| 2. Tells where internal and external threads are found on fasteners                 |      |   |   |   |   |   |   |   |   |    |
| 3. Tells the purpose of threads                                                     |      |   |   |   |   |   |   |   |   |    |
| 4. Names two types of threads found on fasteners                                    |      |   |   |   |   |   |   |   |   |    |
| 5. States which direction to turn fasteners to tighten and loosen them              |      |   |   |   |   |   |   |   |   |    |
| 6. States three kinds of information necessary for ordering replacement fasteners   |      |   |   |   |   |   |   |   |   |    |
| 7. Tells how to measure the length of fasteners                                     |      |   |   |   |   |   |   |   |   |    |
| 8. Tells how to measure the diameter of fasteners                                   |      |   |   |   |   |   |   |   |   |    |
| 9. Tells how to determine the number of threads per inch on a fastener              |      |   |   |   |   |   |   |   |   |    |
| <b>THINGS TO DO</b>                                                                 |      |   |   |   |   |   |   |   |   |    |
| 1. Measures diameter of fasteners accurately                                        |      |   |   |   |   |   |   |   |   |    |
| 2. Measures lengths of fasteners accurately                                         |      |   |   |   |   |   |   |   |   |    |
| 3. Matches correct nut to correct bolt                                              |      |   |   |   |   |   |   |   |   |    |
| 4. Matches sockets and box-end wrenches to fastener heads accurately                |      |   |   |   |   |   |   |   |   |    |
|                                                                                     |      |   |   |   |   |   |   |   |   |    |



Student's Name \_\_\_\_\_

| Measure Spark Plug Gap<br>with a Feeler Gauge                                                            | DAYS |   |   |   |   |   |   |   |   |    |
|----------------------------------------------------------------------------------------------------------|------|---|---|---|---|---|---|---|---|----|
|                                                                                                          | 1    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| <b>EVALUATION CHART</b>                                                                                  |      |   |   |   |   |   |   |   |   |    |
| <b>THINGS TO KNOW</b>                                                                                    |      |   |   |   |   |   |   |   |   |    |
| 1. Tells the reason a round feeler gauge is used to measure the spark gap instead of a flat feeler gauge |      |   |   |   |   |   |   |   |   |    |
| <b>THINGS TO DO</b>                                                                                      |      |   |   |   |   |   |   |   |   |    |
| 1. Locates the correct spark plug gap size in a small engine repair manual                               |      |   |   |   |   |   |   |   |   |    |
| 2. Selects the correct feeler gauge blade for the spark plug gap                                         |      |   |   |   |   |   |   |   |   |    |
| 3. Measures the spark plug gap with a feeler gauge                                                       |      |   |   |   |   |   |   |   |   |    |
| 4. Checks to see that the spark plug gap is correctly set                                                |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |
|                                                                                                          |      |   |   |   |   |   |   |   |   |    |

# **Measuring Valve Stem Gap with Feeler Gauge**

**DAYS**
**EVALUATION CHART**
**1 2 3 4 5 6 7 8 9 10**
**THINGS TO KNOW**

1. Tells the reason the valve stem gap must be set correctly

**THINGS TO DO**

1. Finds the correct valve stem gap setting in a small engine repair manual
2. Selects the correct feeler gauge blade for the valve gap specifications in the repair manual
3. Positions intake valve and exhaust valves for measuring
4. Shows how to measure valve stem gap with feeler gauge
5. Checks both exhaust and intake valve gap for correct setting



## MEASUREMENT: Measure and Match Nuts, Bolts, and Screws

| SLIDE NO. | SLIDE DESCRIPTION<br>                        | NARRATIVE                                                                                                                                                                                     |
|-----------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Focus Slide                                                                                                                   | (Music up)                                                                                                                                                                                    |
| 2         | MEASURING: Measure and Match Nuts, Bolts, and Screws                                                                          | (Music under) Measure and Match Nuts, Bolts, and Screws. (Music out)                                                                                                                          |
| 3         | Assortment of nuts, bolts, and screws                                                                                         | On small gasoline engines there are many types and sizes of screws, bolts, and nuts that hold the engine parts together.                                                                      |
| 4         | Arrow pointing to mounting bolt on shroud                                                                                     | There are mounting bolts found on lawnmower shrouds, . . .                                                                                                                                    |
| 5         | Arrow pointing to screw on air cleaner                                                                                        | and cap screws on air cleaner covers, . . .                                                                                                                                                   |
| 6         | Arrow pointing to oil-drain plug                                                                                              | and even a large, square bolt called the oil-drain plug that holds the oil inside the engine.                                                                                                 |
| 7         | Open-end wrench on shroud bolt                                                                                                | As a small engine mechanic, you will be loosening and tightening different types and sizes of fasteners on engines.                                                                           |
| 8         | Cartoon of questions: How are they sized? What are they? How do you order a replacement? How do you match them with a wrench? | So, you will need to know what fasteners are, how to order a replacement, how they are sized, and how to match them with the correct size wrench or socket.                                   |
| 9         | Close-up of bolt and nut with threads labeled                                                                                 | All screws, bolts, and nuts are fasteners with threads on them. The threads are simply spiral grooves cut around a piece of rounded metal.                                                    |
| 10        | Illustration of nut with internal threads labeled                                                                             | The spiral grooves are called internal threads when they are cut into the inside of a nut. . .                                                                                                |
| 11        | Illustration of bolt with external threads labeled                                                                            | and external threads when they are on the outside of a bolt or screw. The threads are the most important part of a fastener because without threads, the engine parts will not hold together. |

| SLIDE NO. | SLIDE DESCRIPTION                                                                                                           | NARRATIVE                                                                                                                                                                                                            |
|-----------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12        | Bolt with coarse threads and a bolt with fine threads                                                                       | Basically, two types of threads are used on fasteners. One type is the coarse thread and the other is the fine thread.                                                                                               |
| 13        | Illustration of a coarse threaded bolt fastened into two engine parts                                                       | On a fastener with coarse threads the spiral grooves are big, and cut deep into the metal so that when the bolt is tightened into two engine parts, it will give a strong hold.                                      |
| 14        | Illustration of a fine threaded bolt fastened into two engine parts                                                         | On a fine-threaded fastener, the spiral grooves are smaller, closer together, and not cut as deep as coarse threads. A fine-threaded fastener is used to hold two engine parts together that get a lot of vibration. |
| 15        | Bolt and nut with arrow pointing toward right                                                                               | Another important fact to remember is that threads are usually right-handed. This means that the fastener must be turned in a clockwise direction to tighten. . .                                                    |
| 16        | Bolt and nut with arrow pointing toward left                                                                                | and in a counter-clockwise direction to loosen. This is important to know because turning it in the wrong way will ruin the threads.                                                                                 |
| 17        | "Good Threads" Bolt with good threads   "Damaged Threads" Bolt that has been cross-threaded and bolt that has been stripped | For example, turning a fastener in the wrong direction may cause cross-threading or stripping of the threads. When this happens, the fastener can no longer hold the engine parts together.                          |
| 18        | Sign on store indicating store is an authorized parts dealer                                                                | When a replacement fastener is needed on an engine, the quickest and easiest way is to order one from the authorized parts dealer in your town.                                                                      |
| 19        | Broken shroud bolt near shroud. Two men talking                                                                             | To order a replacement fastener, first, tell the dealer the name of the engine part that the bolt, screw, or nut holds together, and then, . . .                                                                     |
| 20        | Engine model number, serial number, and series type. Two men talking                                                        | tell the dealer the engine model number, serial number, and series type that is found on the engine nameplate or stamped into the engine shroud.                                                                     |
| 21        | Dealer holding a bolt and looking in parts manual                                                                           | The dealer will then be able to look in a parts manual to find the exact size replacement fastener that you need.                                                                                                    |

| SLIDE NO. | SLIDE DESCRIPTION                                                                                     | NARRATIVE                                                                                                                                                                                                                                                                              |
|-----------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22        | Person measuring bolt with a ruler                                                                    | If you don't know the necessary information about the engine, then you will have to measure the broken fastener to determine the correct size replacement needed.                                                                                                                      |
| 23        | Illustration of a bolt with its length measured                                                       | First, you will want to measure the bolt length. It is found by measuring under the bolt head to the end of the threads.                                                                                                                                                               |
| 24        | Illustration of a bolt and nut with the widths measured                                               | To find the diameter of a bolt or screw measure the width or across the threads. The diameter of a nut is found by measuring the internal or inside space between the threaded part.                                                                                                   |
| 25        | One inch measured and illustrated on the threaded part of a coarse and fine-threaded bolt             | Then you will need to determine if the bolt has coarse or fine threads. You can do this by counting the number of threads in one inch on the bolt.                                                                                                                                     |
| 26        | Coarse-threaded bolt has 12 points and fine-threaded bolt has 18 points illustrated                   | You will find that the fine-threaded bolt will have more points than the coarse-threaded bolt even though the one-inch distance is the same on both bolts.                                                                                                                             |
| 27        | Chart of the American National Standard Screw Threads                                                 | You could also look on a chart called the "American National Standard Screw Threads" to determine the number of threads per inch on coarse or fine-threaded bolts.                                                                                                                     |
| 28        | Bolt head with a 9/16" open-end wrench on it and a side view of a bolt with a diameter measuring 3/8" | Now, let's talk about how to find the correct wrench or socket size for a fastener. You will need to remember that the tool size will always be larger than the diameter of the fastener. Notice in this picture that a three-eighths inch bolt requires a nine-sixteenth inch wrench. |
| 29        | Bolt head measured between two opposite flat sides. Nut measured between two opposite flat sides      | The wrench or socket size needed for use on fasteners is found by measuring the distance between two opposite, flat sides of the bolt or screw head. On a nut, you would also measure the distance between two opposite flat sides.                                                    |
| 30        | Hand fitting a 3/4" open-end wrench on a 5/8" bolt head                                               | The easiest way to find the correct wrench or socket size is to try fitting different sizes on the fastener until you find the correct fit.                                                                                                                                            |
| 31        | Hand fitting a 1/2" open-end wrench on a 1/2" bolt head                                               | You will know that the fit is correct when the flat sides of the nut or bolt head fit the flat sides of the wrench or socket, and that the wrench or socket does not easily slip around on the fastener.                                                                               |

| SLIDE NO. | SLIDE DESCRIPTION                                                              |                                          | NARRATIVE                                                                                                                                                                                                                                                                                                                        |
|-----------|--------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32        | Close up of 1/2" open-end wrench on a 1/2" bolt. Size on wrench is circled.    |                                          | Recognizing the correct wrench or socket size for the fastener will take practice. So while you are learning, look at the size marked on the tool each time you match the correct size. After awhile, you will learn how to match the correct tool size by just looking at the fastener.                                         |
| 33        | "Follow these SAFETY RULES"                                                    |                                          | When using wrenches and sockets or fasteners, there are several safety rules that need to be followed besides matching the correct sizes.                                                                                                                                                                                        |
| 34        | Wrench fitted correctly onto bolt head                                         | Wrench fitted incorrectly onto bolt head | A safety rule for using an open-end wrench is to properly fit it onto two opposite, flat sides of the bolt head or nut. If it is forced onto the corners, as it is in the picture on the right, then the corners will be rounded off and the wrench will slip around the fastener and make it difficult to loosen or tighten it. |
| 35        | Wrench turning bolt in clockwise direction. Arrow pointing to the right        |                                          | As we have already said, one of the most important rules to remember is which direction to turn for tightening, and which direction to turn for loosening a fastener. To tighten a fastener, turn the wrench in a clockwise direction, or to the right, . .                                                                      |
| 36        | Wrench turning bolt in counter-clockwise direction. Arrow pointing to the left |                                          | and to loosen a fastener, turn the wrench in a counter-clockwise direction or to the left.                                                                                                                                                                                                                                       |
| 37        | Broken bolt near engine                                                        |                                          | Try to remember this rule because turning a fastener in the wrong direction could be a very expensive mistake. If a fastener is turned in the wrong direction, the fastener could become too tight in the engine and then accidentally bend or break.                                                                            |
| 38        | Hammer hitting wrench, broken bolt nearby                                      |                                          | Another precaution to follow when loosening a bolt or nut is to never use anything stronger than your hands on the wrench. Using something else, such as a hammer, could easily break the fastener and wrench.                                                                                                                   |
| 39        | Hand pulling down on wrench that is fitted onto a bolt head                    |                                          | To get the most leverage when loosening a fastener, always pull down on the tool rather than pushing up on it with your hands.                                                                                                                                                                                                   |
| 40        | Hand pulling down on box-end wrench that is fitted onto a bolt                 |                                          | If a bolt or nut seems to be stuck and difficult to loosen with an open-end wrench, then use the correct size box-end wrench or socket, so that pressure will be applied to all sides of the fastener and not just on two sides.                                                                                                 |

| SLIDE NO. | SLIDE DESCRIPTION                                                                                               | NARRATIVE                                                                                                                                                                                                                                                        |
|-----------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 41        | Assembly of 4, 6, 8, and 12-point sockets. Each socket is labeled                                               | When using a socket set, there are different numbers of notches or points that are found around the inside of socket openings. Most tool kits have sockets with 6, 8, and 12 points, and sometimes one or two small 4-point sockets.                             |
| 42        | Close-up of hexagon nut and a 6-point socket                                                                    | With most hexagon-shaped or six-sided nuts and bolts, a 12-point socket can be used, but if a lot of force is needed to loosen the fastener, then a 6-point socket should be used.                                                                               |
| 43        | Close-up of square bolt and an 8-point socket                                                                   | For square-head bolts, such as the oil-drain plug, use an 8-point socket since it is safer to use and will fit better than a 12-point socket.                                                                                                                    |
| 44        | Hand picking up a standard-depth socket. Deep socket nearby                                                     | Select standard-depth sockets for removing and replacing most fasteners on small engines, . . .                                                                                                                                                                  |
| 45        | Close-up of deep socket near a spark plug                                                                       | except for deep sockets, which are especially made for loosening and tightening such things as the spark plug and nuts on extended bolts or studs.                                                                                                               |
| 46        | Close-up of hands holding a socket and nut driver on a bolt                                                     | A final safety rule is to hold the socket squarely onto the bolt head so that force is evenly applied to all sides, and that not any one side of the bolt receives more force where it could easily be damaged. Use both hands to do this.                       |
| 47        | Student at work bench with assortment of bolts, sockets, and wrenches. Student is matching a socket with a bolt | You should now know what fasteners are, how to order a replacement, how they are sized, and how to match them with the correct wrench or socket size. Practice this information and (music under) remember to follow all the safety rules that you have learned. |
| 48        | (Credit slide)                                                                                                  | (Music up and out)                                                                                                                                                                                                                                               |
|           |                                                                                                                 |                                                                                                                                                                                                                                                                  |

## MEASUREMENT: Measure with a Rule

| SLIDE NO. | SLIDE DESCRIPTION                                                                             | NARRATIVE                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Focus Slide  | (Music up)                                                                                                                                                                                                                                                                                                                                                                                        |
| 2         | Title slide                                                                                   | Measure With a Rule                                                                                                                                                                                                                                                                                                                                                                               |
| 3         | Several measuring instruments                                                                 | As a small engine mechanic, you will need to know how to use various types of measuring instruments.                                                                                                                                                                                                                                                                                              |
| 4         | Photo of rule                                                                                 | Today you will learn how to use a rule.                                                                                                                                                                                                                                                                                                                                                           |
| 5         | Artwork emphasizing -- rule                                                                   | The rule we will use is a twelve-inch rule.                                                                                                                                                                                                                                                                                                                                                       |
| 6         | Points out lines and numbers                                                                  | The twelve-inch rule has lines and numbers..                                                                                                                                                                                                                                                                                                                                                      |
| 7         | Closeup of rules lines and numbers                                                            | The lines are used to divide the rule into parts or spaces.                                                                                                                                                                                                                                                                                                                                       |
| 8         | Shows 1" line and number 1                                                                    | The longest lines divide the rule into inches and have numbers beside them.                                                                                                                                                                                                                                                                                                                       |
| 9         | Emphasizes 1"                                                                                 | From the end of the rule to the long line with the number 1 beside it measures one inch.                                                                                                                                                                                                                                                                                                          |
| 10        | Shows correct placement of rule for measuring accurately                                      | To measure in inches, place the rule next to the point where you want to begin measuring. If the end of the rule and the point of the object to be measured are not exactly lined up, then your measurement will not be accurate.                                                                                                                                                                 |
| 11        | Pictures the correct way to measure a bolt                                                    | Now, count the number of inches from left to right until you get to the end of the object being measured. The last number that you read tells you the length of the object. In this picture, the length of the bolt being measured is three inches.                                                                                                                                               |
| 12        | Activity Sheet One                                                                            | To give you some practice in measuring whole inches, your teacher will stop this presentation and give you Activity Sheet 1 to complete. You will need a twelve-inch rule and a pencil to do the measuring activities. When you are through, the presentation will be turned on and you will be able to find out if you have measured accurately. Now, stop the recorder and do Activity Sheet 1. |

| SLIDE NO. | SLIDE DESCRIPTION                         | NARRATIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13        | Answers to Activity Sheet 1               | Now that you have finished Activity Sheet 1, check your answers on Parts A and B with the answers you see on the slide. Your teacher will check Part C. Do you think that you can measure in inches now? If so, and you missed only one of the measuring problems, then let's go on with this presentation.                                                                                                                                                                              |
| 14        | Closeup of an inch                        | Look closely at this inch. Within an inch there are several lines. Some are shorter than others and some are longer. These lines divide the inch into parts, which are called fractions of the whole inch.                                                                                                                                                                                                                                                                               |
| 15        | Shows length of half-inch line            | Within the inch, the half-inch line will be the longest line...as shown here.                                                                                                                                                                                                                                                                                                                                                                                                            |
| 16        | Correct way to measure in one-half inches | To measure in whole and one-half inches, place the rule next to the point where you want to begin measuring. Now, count the number of whole inches and then any left over half-inches.                                                                                                                                                                                                                                                                                                   |
| 17        | Counting spaces                           | One inch...two inches...and one-half inch. This bolt measures two and one-half inches.                                                                                                                                                                                                                                                                                                                                                                                                   |
| 18        | Activity Sheet Two                        | Now, let's see if you can measure in whole and one-half inches. The recorder will be stopped and you will be given Activity Sheet 2 to complete. When you are through with this measuring activity, turn the recorder back on to find out how well you did.                                                                                                                                                                                                                              |
| 19        | Answers to Activity Sheet 2               | How did you do on measuring in whole and one-half inches? To find out, check your answers on Parts A and B with the answers you see on the slide. Your teacher will check Part C. If you missed more than two of the problems, then you probably need more practice. Stop this presentation and your teacher will give you more practice in measuring in whole and one-half inches. If you missed only one problem, then let's learn how to measure in one-fourth and one-eighth inches. |
| 20        | Introduction to one-fourth inches         | Look closely again at the inch. Just as an inch can be divided into halves, it can also be divided into four equal parts called fourths. When counting fourth lines within an inch, count "one-fourth...one-half (which is the same thing as two-fourths), three-fourths, and one-inch (which is the same as 4 fourths)"                                                                                                                                                                 |
| 21        | Correct placement of rule                 | To measure in whole and one-fourth inches, place the rule next to the point where you want to begin measuring. Now, count the number of whole inches and then any left over fourth inches.                                                                                                                                                                                                                                                                                               |
| 22        | Counting spaces                           | One inch...two inches...and one-fourth inch. This bolt measures two and one-fourth inches.                                                                                                                                                                                                                                                                                                                                                                                               |

| SLIDE NO. | SLIDE DESCRIPTION                                     | NARRATIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23        | Activity Sheet Three                                  | Now, stop this presentation and practice measuring in whole and one-fourth inches. You will need Activity Sheet 3, a rule, and a pencil. As you do the measuring activities, remember to line up the edge of the rule exactly with the point of the object to be measured because without doing this, your measurements will be wrong.                                                                                                                                                              |
| 24        | Answers to Activity Sheet 3                           | Did you find that measuring in whole and fourth inches is harder than measuring in half inches? Check your answers on Parts A and B with the answers you see on the slide. Your teacher will check Part C. If you missed more than two of these measuring problems, then you need more practice. Stop this presentation so that your teacher can give you more practice in measuring in whole and one-fourth inches. If you missed less than two problems, then let's go on with this presentation. |
| 25        | Introduction to one-eighth inches                     | Look once again at the inch. On most rules, an inch will also be divided into eight equal parts (or fractions) of an inch called eighths. When counting the eighths within an inch...read from left to right and say..."one-eighth, two-eighths...which is one fourth, three-eighths, four-eighths...which is one-half, five-eighths, six-eighths...which is three-fourths, seven-eighths, and one inch...which is 8 eighths."                                                                      |
| 26        | Introduction to fractions involving one-eighth inches | To better understand the one-eighths inches on a rule, you must be able to reduce fractions. For example: The distance from A to B is $\frac{5}{8}$ ". This fraction cannot be reduced anymore, because the top number (5) is an odd number.                                                                                                                                                                                                                                                        |
| 27        | Explanation of odd numerator                          | So any time your top number in a one-eighth inch fraction is an odd number (such as 1, 3, 5, or 7) the fraction cannot be reduced down any further, because 2 will not divide into any of the numbers evenly.                                                                                                                                                                                                                                                                                       |
| 28        | Explanation of even numerator                         | Anytime the top number in a one-eighth inch fraction is an even number (such as 2, 4, 6, 8) it can be reduced because the number 2 will divide into it evenly.                                                                                                                                                                                                                                                                                                                                      |
| 29        | Question concerning reduction of fraction             | The distance between A and B in this problem is $\frac{6}{8}$ ". Can $\frac{6}{8}$ " be reduced down any further? (Pause) Yes, Why? (class reaction) That's right, because 6 is an even number.                                                                                                                                                                                                                                                                                                     |
| 30        | Explanation of fraction reduction                     | Not let's reduce six-eighths until we have an odd number on top. For example, 2 will go into 6 three times and 2 will go into 8 four times, so the correct answer is $\frac{3}{4}$ .                                                                                                                                                                                                                                                                                                                |
| 31        | Activity Sheet Four                                   | Stop this presentation and practice measuring in whole inches and eighths. Be sure to reduce your answer until the top number is an odd number (1, 3, 5, or 7). Your teacher will give you Activity Sheet 4 when you are through with this measuring activity; turn your recorder back on to find out how well you did.                                                                                                                                                                             |

| SLIDE NO. | SLIDE DESCRIPTION                                     | NARRATIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32        | Answers to Activity Sheet 4                           | How did you do measuring in whole and eighths of an inch? To find out, check your answers with these. For Part C, have your teacher check the length of your lines. (Pause) If you missed more than two of the problems, then you probably need more practice.                                                                                                                                                                                                                                                                                                                            |
| 33        | Introduction to measuring in one-sixteenth inches     | Look closely again at the inch. Just as an inch can be divided into fourths and eighths, it can also be divided into sixteen equal parts called sixteenths. When counting sixteenth lines within an inch, count "one-sixteenths, two-sixteenths (one-eighth), three-sixteenths, four-sixteenths (one fourth), ten sixteenths (five-eighths), eleven-sixteenths, twelve-sixteenths (which is the same thing as six-eighths, and six-eighths is the same thing as three-fourths), thirteen-sixteenths, fourteen-sixteenths (seven-eighths), sixteen-sixteenths (eight-eighths) or one inch. |
| 34        | Introduction to fractions involving one-sixteenths    | To understand one-sixteenth marks on a ruler better, you must be able to reduce fractions. For example, the distance from A to B is seven-sixteenths of an inch. This fraction cannot be reduced down any more because the top number (7) is an odd number.                                                                                                                                                                                                                                                                                                                               |
| 35        | Explanation of odd numerator                          | So, anytime your top number in a one-sixteenth fraction is an odd number, (such as 1, 3, 5, 7, 9, 11, 13, or 15) the fraction cannot be reduced, because 2 will not divide into any of the numbers evenly.                                                                                                                                                                                                                                                                                                                                                                                |
| 36        | Explanation of even numerator                         | Any time the top number in a one-sixteenth fraction is an even number (2, 4, 6, 8, 10, 12, 14, or 16), it can be reduced because 2 will divide into it evenly.                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 37        | Question concerning fraction 12/16                    | The distance between A and B in this problem is 12/16". Can 12/16 be reduced any further? (Pause) Yes. Why? That's right, because 12 is an even number.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 38        | Showing reduction of 12/16                            | Now, let's reduce 12/16" until we have an odd number on top. Two will go into 12 six times - 2 will go into 16 eight times, can 6/8" be reduced down any further? (Pause) Yes. Why? That's right, because 6 is an even number.                                                                                                                                                                                                                                                                                                                                                            |
| 39        | Reduction of 6/8 and question about further reduction | Let's reduce 6/8" until we have an odd number on top. Two will go into 6 three times - 2 will go into 8 four times, can 3/4" be reduced down any further? No. Why? That's right, because 3 is an odd number.                                                                                                                                                                                                                                                                                                                                                                              |
| 40        | Answer to reduction of 6/8                            | So the correct answer is 3/4".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 41        | Activity Sheet 5                                      | Now, stop this presentation and practice measuring in whole and sixteenths. You will need Activity Sheet 5. When you are through with this measuring activity, turn the recorder back on to find out how well you did.                                                                                                                                                                                                                                                                                                                                                                    |

| SLIDE NO. | SLIDE DESCRIPTION                                                                                | NARRATIVE                                                                                                                                                                                                                                                                                                                                                       |
|-----------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 42        | Answers to Activity Sheet 5                                                                      | Was measuring in whole and sixteenths harder than measuring in eighths of an inch? Check your answers with these. To check Part C, let the teacher measure your lines for the correct length. (Pause) If you missed more than two of these measuring problems, then you need more practice.                                                                     |
| 43        | Review of steps in measuring                                                                     | Now, let's review the steps in measuring in inches and fractions or parts of the inch.                                                                                                                                                                                                                                                                          |
| 44        | Close-up showing longest line that also has a number                                             | The longest line, or the line with a number beside it, is called the inch line.                                                                                                                                                                                                                                                                                 |
| 45        | Comparison of half-inch line and inch line.                                                      | The half-inch line is shorter than the inch line.                                                                                                                                                                                                                                                                                                               |
| 46        | Comparison of one-fourth line and half-inch line                                                 | The fourth-inch line is shorter than the half-inch line.                                                                                                                                                                                                                                                                                                        |
| 47        | Comparison of eighth-inch line and fourth-inch line                                              | And the eighth-inch line is shorter than the fourth-inch line. easily                                                                                                                                                                                                                                                                                           |
| 48        | Comparison of sixteenth-inch line and eighth-inch line                                           | And the sixteenth inch line is shorter than the eighth-inch line. You can easily see that the smaller the part, the shorter the line will be.                                                                                                                                                                                                                   |
| 49        | Visual says, "The smaller the part--the shorter the line"                                        | The lines on rules are made this way to help you determine the fractional part without having to count all the lines in an inch.                                                                                                                                                                                                                                |
| 50        | Picture of student measuring                                                                     | With practice, you will learn to quickly recognize the lines and their fractional meanings just by looking at the length of the line.                                                                                                                                                                                                                           |
| 51        | Visual showing fractions of one inch, one-half, one-fourth, one-eighth, and one-sixteenth inches | This completes the presentation on MEASURE WITH A RULE. You should now know how to measure in whole inches, halves, fourths, eighths, and sixteenths of an inch. Let's find out if you can.                                                                                                                                                                     |
| 52        | Activity Sheet Six                                                                               | Now, stop the recorder and you teacher will give you Activity Sheet 6 to do. The measuring problems on this activity sheet will cover all of the measurement skills you will need to have for measuring with a rule. (Music under) When you have finished, the presentation will be turned on and you will be able to find out if you have measured accurately. |

| SLIDE NO. | SLIDE DESCRIPTION             | NARRATIVE                                                                                 |
|-----------|-------------------------------|-------------------------------------------------------------------------------------------|
| 53        | Answers to Activity Sheet Six | If you miss several of the measuring problems, you will need to review this presentation. |
| 54        | Credits                       | (Music up and out)                                                                        |
|           |                               |                                                                                           |

## MEASUREMENT: Measure with a Spark Plug Gauge and a Feeler Gauge

| SLIDE NO. | SLIDE DESCRIPTION                                                                                | NARRATIVE                                                                                                                                                                                          |
|-----------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Focus Slide<br> | (Music begins here)                                                                                                                                                                                |
| 2         | (Title slide) Measuring Spark PLUG Gap with Feeler Gauge                                         | Measuring Spark Plug Gap with Feeler Gauge (Music fades out here)                                                                                                                                  |
| 3         | Slide showing mechanic removing spark plug from engine                                           | The spark plug should be removed from the engine at the beginning of mowing season, cleaned and the gap reset.                                                                                     |
| 4         | Close-up of spark plug                                                                           | One of the most important steps in servicing a spark plug is knowing how to measure the gap between the two electrodes.                                                                            |
| 5         | Tools laid out on work table: spark plug, two feeler gauges (round and flat), gap setter         | Before beginning to measure the gap on a spark plug, you will want to gather all the tools you will need to use for this job.                                                                      |
| 6         | Round feeler gauge                                                                               | You will need a round feeler gauge for measuring the gap between the two electrodes.                                                                                                               |
| 7         | Flat feeler gauge                                                                                | You may use a flat feeler gauge in setting the spark gap on a used plug if the end of the ground electrode has not been eaten away by the spark.                                                   |
| 8         | Illustration                                                                                     | For example, a flat feeler gauge may not give an accurate measurement of the plug gap if the two electrodes are not flat.                                                                          |
| 9         | Illustration                                                                                     | Notice how the wire gauge does not leave any space between the two electrodes, as the flat feeler gauge did.                                                                                       |
| 10        | Arrow pointing to the gap between the ground electrode and the central electrode                 | The gap between the two electrodes must be set correctly.                                                                                                                                          |
| 11        | Hand pointing to correct setting in shop repair manual                                           | You can look up what the spark plug gap size should be in the shop repair manual for your engine. Almost all engines use a gap setting of .030 of an inch, which is about the thickness of a dime. |

| SLIDE NO. | SLIDE DESCRIPTION                                                     | NARRATIVE                                                                                                                                                                  |
|-----------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12        | Finger pointing to correct size on wire gauge                         | To find the correct wire size, take the number you found in the shop repair manual and locate that same number on your wire gauge.                                         |
| 13        | Hand/wire gauge being inserted between the two electrodes             | Next, slide the correct wire gauge size into the space between the electrodes. It should fit snugly.                                                                       |
| 14        | Hand/wire gauge not fitting between electrodes                        | If the wire gauge will not go between the electrodes, the gap between the two electrodes is too small.                                                                     |
| 15        | Hand/wire gauge fitting correctly between the electrodes              | If the wire gauge and the spark plug gap are the same size, the wire gauge will feel snug as it is moved in and out between the ground electrode and the center electrode. |
| 16        | Hand holding a properly serviced spark plug                           | This is what a properly serviced spark plug should look like after the spark gap has been measured and adjusted properly.                                                  |
| 17        | Mechanic picking up tools                                             | Clean your work area and return the tools to the tool room before you start another job. (Music fades in here.)                                                            |
| 18        | (Credit slide)                                                        | (Music stops here)                                                                                                                                                         |
| 19        |                                                                       | (Music begins here)                                                                                                                                                        |
| 20        | (Title slide) Measuring Contact Point Gap with Feeler Gauge           | Measuring Contact Point Gap with Feeler Gauge (Music fades out here)                                                                                                       |
| 21        | Book picture showing contact points, flat feeler gauge, screwdriver   | One of the most important steps in replacing contact points is measuring the gap between the contact points, after they have been installed.                               |
| 22        | Tools layed out on work bench: flat feeler gauge standard screwdriver | Before beginning to measure the gap between the contact points, you will want to gather all the tools you need to use for this job.                                        |

| SLIDE NO. | SLIDE DESCRIPTION                                                                | NARRATIVE                                                                                                                                                                     |
|-----------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23        | Hand holding a flat feeler gauge                                                 | You will also need a flat feeler gauge to set the gap between the points.                                                                                                     |
| 24        | Illustration                                                                     | The gap between the points must be set correctly in order for your engine to run smoothly.                                                                                    |
| 25        | Illustration                                                                     | Your points must also line up with each other, if they are to work properly.                                                                                                  |
| 26        | Pencil pointing to correct setting in shop repair manual                         | You can look up what the point gap size should be in your shop repair manual under the section labeled "Ignition."                                                            |
| 27        | Hand turning crankshaft                                                          | Turn the crankshaft until contact points are open to their widest gap.                                                                                                        |
| 28        | Slide showing flat feeler gauge between contact points                           | Put the correct size feeler gauge blade between the two contact points.                                                                                                       |
| 29        | Slide showing nut driver loosening point and arrow showing direction to loosen   | Adjust the gap by loosening the hold-down screw just enough to loosen the stationery point. <u>REMEMBER</u> --To loosen, turn the screw to the left.                          |
| 30        | Slide showing no gap between feeler gauge and contact points.                    | Now, slide the loosened contact point against the blade on the feeler gauge. The blade should be touching both contact points.                                                |
| 31        | Slide showing nut driver tightening point and arrow showing direction to tighten | While the feeler gauge is still in place, tighten the hold-down screw. The gap is adjusted properly when the feeler gauge will slide in and out of the gap with a light drag. |
| 32        | Slide showing feeler gauge blade between points                                  | Finally, recheck the point gap with the feeler gauge. The stationery point could have moved when you tightened the contact point hold-down screw.                             |
| 33        | Mechanic picking up tools                                                        | Return all tools to the tool room before you start another job. (Music starts here)                                                                                           |
| 34        | (Credit slide)                                                                   | (Music stops here)                                                                                                                                                            |

| SLIDE NO. | SLIDE DESCRIPTION                                                                      | NARRATIVE                                                                                                                                                            |
|-----------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35        |                                                                                        | (Music beings here)                                                                                                                                                  |
| 36        | (Title slide) Measuring Valve Stem Gap with Feeler Gauge                               | Measuring Valve Stem Gap with Feeler Gauge                                                                                                                           |
| 37        | Picture of a feeler gauge being inserted under the valve stem in engine                | In order for the valve to seat properly in the cylinder head, the gap under the intake valve stem and the exhaust valve stem must be measured correctly.             |
| 38        | Picture of a flat feeler gauge                                                         | A flat feeler gauge will be the only tool you will need for this job.                                                                                                |
| 39        | Picture of a flat feeler gauge                                                         | You will need a flat feeler gauge to measure and set the gap on the intake valve and the exhaust valve.                                                              |
| 40        | Picture of pencil pointing to section in shop repair manual labeled "Valve Clearance." | To find the correct gap setting for the intake valve look in your shop repair manual under the heading "Valve Clearance."                                            |
| 41        | Picture of pencil pointing to correct gap settings for the intake valve                | If the intake valve is set correctly, the gap will take either a .005 feeler gauge blade, .006 feeler gauge, or a .007 feeler gauge blade.                           |
| 42        | Picture showing intake valve head against intake valve seat                            | Before you measure the intake valve stem gap make sure both valves are closed against the valve seat.                                                                |
| 43        | Picture showing a feeler gauge blade in intake valve gap                               | If any one of the three blades will fit in the gap between the intake valve stem and the lifter and has a light pull when being taken out, the gap is set correctly. |
| 44        | Picture of engine with arrow pointing to exhaust valve                                 | Now you are ready to measure the gap under the exhaust valve stem.                                                                                                   |
| 45        | Picture of pencil pointing to section in shop repair manual labeled "Valve Clearance." | To find the correct gap setting for the exhaust valve, look back in your shop repair manual under "Exhaust Valve Clearance."                                         |

| SLIDE NO. | SLIDE DESCRIPTION                                                        | NARRATIVE                                                                                                                                                                                         |
|-----------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 46        | Picture of pencil pointing to correct gap settings for the exhaust valve | If the exhaust valve is set correctly, the gap will take either a .009 feeler gauge blade, .010 feeler gauge blade, or a .011 feeler gauge blade, which is about the thickness of a playing card. |
| 47        | Picture showing valves closed against valve seats                        | Before you measure the exhaust valve gap, make sure the exhaust valve is closed.                                                                                                                  |
| 48        | Picture showing feeler gauge blade in exhaust gap                        | If any one of the three blades will fit in the gap between the exhaust valve stem and the lifter and has a light pull when being taken out, the gap is set correctly.                             |
| 49        | Picture of the flat feeler gauge                                         | Make sure when you have finished with the flat feeler gauge, it is returned to the tool room. (Music up here).                                                                                    |
| 50        | (Credit slide)                                                           | (Music up and out.)                                                                                                                                                                               |
|           |                                                                          |                                                                                                                                                                                                   |

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